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SCIENCE

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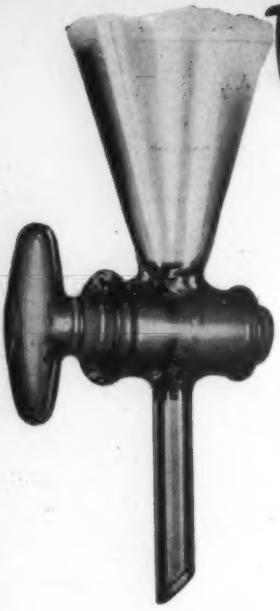

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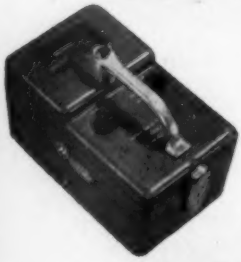

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The New Stem Rust Threat

A REAL threat to the food supplies of this country is Race 15-B of stem rust. Last year we lost 10 million bushels of durum wheat alone, which was about one fifth of the crop. Losses would undoubtedly have been much greater except for the fact that last year most of the bread wheat varieties matured before the disease reached epidemic proportions.

What will happen to this year's crop is anyone's guess. Much depends on the build-up of inoculum in southern Texas, the condition of the grain farther north, and the weather. Abundance of inoculum and warm, humid weather are ideal for development of the rust.

Race 15-B is the most virulent race of stem rust of wheat ever found in North America. Although it has been known to exist on barberries since 1939, it was never found in a commercial wheat field until last summer. It appeared suddenly in 15 states from Texas to Manitoba, and from Idaho to Ohio.

Last year's losses were the first serious damage from stem rust on spring wheat in 15 years, because improved varieties now in commercial use are resistant to all the old races of stem rust. No commercial variety now grown in North America has resistance to 15-B.

Rust spores can survive winters in southern Texas and northern Mexico on the growing grain. In addition, however, they overwinter in a different spore stage on straw and stubble in the northern part of the United States and spread to barberries in the spring. From barberries they go back to grains and grasses, causing local epidemics. Without the barberry they cannot spread. The U.S. Department of Agriculture and most of the wheat states have cooperated for many years to eradicate the common barberry. Large areas have been cleared, but the job is obviously one of huge proportions that will require periodic rechecking until all are eradicated.

An interesting feature of the barberry relationship to rust is that strains of the fungus hybridize while living on barberries, and new races result. Thus, while man is hybridizing wheats, nature is hybridizing the rust fungus.

Because of the relation between barberries and rust, the 15-B situation is being attacked by renewed efforts to eradicate barberries and by speeding up efforts to develop varieties that combine resistance to 15-B with acceptable agronomic and bread-making qualities.

Wheat breeders from all over North America are methodically testing all lines of breeding material for resistance to the new strain of rust. A coordinated attack on the disease began last fall and is currently going on. At Beltsville, at several state agricultural experiment stations, and in Canada, pathologists and plant breeders are testing thousands of strains from the World Collection of wheats, which numbers approximately 13,500. So far several sources of resistance to 15-B have been found, but none is adaptable to commercial wheat growing.

Among the lines so far tested, some of the introductions from Kenya, Africa, and from Egypt have shown outstanding resistance. Wheat breeders had already crossed some of these strains with commercial wheats adapted in this country. More crosses were made last winter. These are undergoing test throughout the country.

As a precautionary move, about 800 wheats were sent to Brazil, Argentina, Peru, Chile, Ecuador, Colombia, and Mexico last spring. Some of the most virulent races of stem rust so far encountered are known to be present in Latin America. International cooperation in testing of breeding material is now a routine part of present-day plant-breeding operations.

There is little reason to doubt that we shall be able to develop wheats resistant to 15-B with all the other qualities necessary for commercial production. The techniques are well established. The only question is how long it will take. With good luck, we may be able to do this in the relatively near future.

H. A. RODENHISER
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Agricultural Research Administration
U. S. Department of Agriculture
Washington, D. C.

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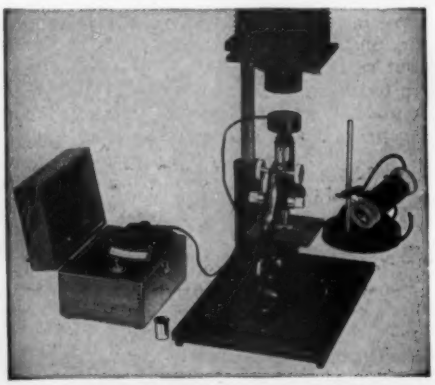

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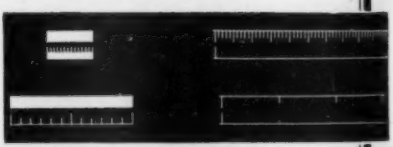

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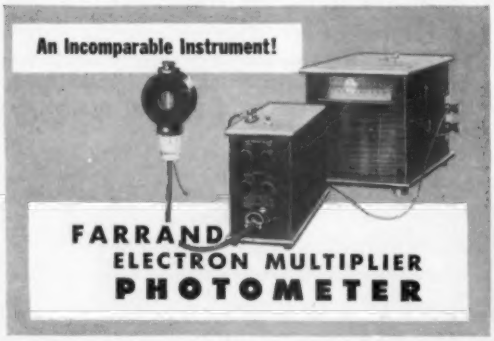

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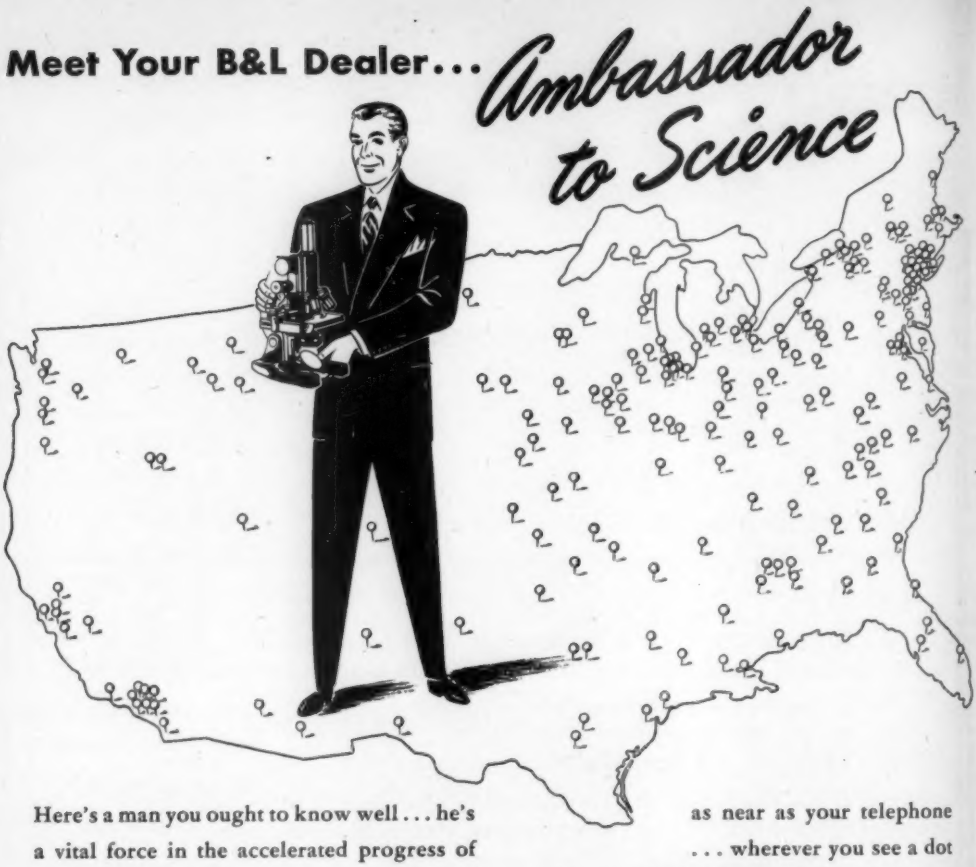

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The Origins of American Scientists

Robert H. Knapp and Hubert B. Goodrich
Wesleyan University, Middletown, Connecticut

FOUR YEARS AGO a committee of the Wesleyan science faculty was appointed to investigate some problems germane to the undergraduate training of scientists. This committee, supported by funds from the Carnegie Corporation and the trustees of the university, has in the past three years devoted itself to a study of the undergraduate origins of American scientists and to an examination of the factors that account for the varying achievements of American colleges and universities. The findings of this study are so pertinent to the manpower problems currently under consideration that we wish to present a part of the more extensive report now in preparation.

Obviously, at the outset, it was necessary to evolve some sort of index of the production of scientists which might be computed for the several hundred institutions of the nation whose graduates have continued to full professional status. The index finally evolved was the rate per thousand at which male graduates of the institution between 1924 and 1934 continued to a doctoral level and were listed in the seventh (1944) edition of *American Men of Science*. The index was confined to men only, in order to eliminate any discrimination against coeducational institutions. The time interval was selected in order to avoid, on one hand, the disruptions of the first World War and, on the other, the more recent years for which our data were necessarily inaccurate. Although the statistics reported in this paper deal with the index just described, it is important to indicate that a second index was used, based upon another listing of American scientists compiled by the National Research Council. Correlations between these two indexes proved to be very high, justifying, we believe, our confidence in the validity of our basic index.

We present in Table 1 the first 50 institutions with 30 or more annual graduates, ranked in order of their production index.

The reader will notice that only four universities of eminent reputation appear on this list, that several state colleges devoted to agricultural technology appear, but that the vast majority are small liberal arts colleges, many of obscure reputation. It must, of course, be emphasized that these indexes are subject to substantial error of measurement, and that among the smaller institutions this error is very appreciable. Still, as we shall see, the superior achievement of the liberal arts colleges is sustained even when this factor is taken into account. One may note further that among the first 50 there is a great preponderance from the Middle and Far West. No Southern institutions appear here, and only eight in the New England and Middle Atlantic states. With these significant observations in mind, let us consider the achievements of different classes of institutions.

TABLE 1

	Name	Location	P. I.
1.	Reed	Ore.	131.8
2.	California Institute of Technology	Calif.	70.1
3.	Kalamazoo	Mich.	66.3
4.	Earlham	Ind.	57.5
5.	Oberlin	Ohio	55.8
6.	Massachusetts State College (Univ. of Mass.)	Mass.	55.6
7.	Hope	Mich.	51.1
8.	DePauw University	Ill.	47.6
9.	Nebraska Wesleyan University	Neb.	47.4
10.	Iowa Wesleyan	Iowa	45.5
11.	Antioch	Ohio	45.1
12.	Marietta	Ohio	45.1
13.	Colorado	Colo.	43.9
14.	Cornell	Iowa	41.2
15.	Central	Mo.	39.9
16.	Chicago, University of	Ill.	39.9
17.	Haverford	Pa.	39.4
18.	Clark University	Mass.	39.0
19.	Johns Hopkins University	Md.	37.3
20.	Emporia	Kan.	36.5
21.	Pomona	Calif.	36.0
22.	Wesleyan University	Conn.	34.3
23.	St. Olaf	Minn.	34.2
24.	Montana State	Mont.	33.9
25.	Utah State Agricultural	Utah	33.4
26.	Beloit	Wis.	32.9
27.	Bluffton	Ohio	31.8
28.	Carleton	Minn.	31.6
29.	Charleston	S. C.	31.6
30.	Wooster	Ohio	31.4
31.	Willamette University	Ore.	31.2
32.	Brigham Young University	Utah	30.4
33.	Swarthmore	Pa.	30.2
34.	Southwestern	Kan.	30.1
35.	Lawrence	Wis.	29.9
36.	Wabash	Ind.	29.9
37.	West Virginia Wesleyan	W. Va.	29.8
38.	Rochester, University of	N. Y.	28.2
39.	Westminster	Mo.	28.0
40.	Simpson	Iowa	27.6
41.	Hiram	Ohio	27.4
42.	Grinnell	Iowa	27.3
43.	Drury	Mo.	26.5
44.	Miami University	Ohio	26.4
45.	Wisconsin, University of	Wis.	26.2
46.	Muskingum	Ohio	25.7
47.	Butler University	Ind.	25.4
48.	Eureka	Ill.	25.0
49.	Lebanon Valley	Pa.	24.7
50.	South Dakota School of Mines	S. D.	24.6

In order to make such comparisons, several homogeneous samples were selected. The first, called the college sample, included all institutions graduating from 30 to 200 students annually, privately endowed, not devoted to technological or other specialized training, and not including any Catholic institutions. The second sample comprised 50 eminent universities, all graduating more than 250 annually, all with graduate schools, but not including teachers' colleges, technological schools, or Catholic institutions. Third, we grouped together all Catholic institutions, large and small. Fourth, employing the listing in the *College Blue Book* for 1934, we obtained a sample of engineering institutions. Finally, employing the same source, we obtained a sample of state-supported institutions devoted primarily to agriculture. The average rate of production of each of these samples is given in Table 2:

TABLE 2

Liberal arts colleges	17.8
Universities	13.8
Catholic institutions	2.8
Engineering schools	6.4
Agricultural colleges	19.8

The casual reader may well be impressed with the record of the agricultural schools which, in comparison with the engineering schools, are more than three times as productive on the average. But it should be borne in mind that in both engineering institutions and agricultural colleges virtually all students concentrate in science or in some applied phase of it. Among the universities, liberal arts colleges, and Catholic institutions the figure is only about a third. It will thus be seen that the liberal arts colleges and universities are at least several times more productive than the institutions of technological emphasis, if this correction be allowed. The difference between our selected universities and the 153 institutions constituting our college sample is clearly significant, though the critical reader may question the legitimacy of employing means in comparing the central tendency of skewed distributions. Suffice it to say, by appropriate statistical procedures it may be demonstrated that this ill-selected body of liberal arts colleges is significantly more productive. One may note with considerable interest that, if only those colleges exceeding 60 annual graduates are considered, their average rate of production increases to 19.4. The superiority of these liberal arts colleges is the more impressive when it is pointed out that on the average their cost of attendance is more than $100 a year less than that of the universities.

The next stage of our inquiry was directed to an intensive examination of the two largest samples reported above, namely, the college sample of 153 and the university sample of 50 cases. For the first of these, 19 separate educational indexes were determined for each institution; for the second, 14 such factors. Efforts were then made by various correlation procedures to relate the index of production of scientists in both samples to these independent variables. Two common factors emerged. First, a geographic gradient in the production of scientists was manifest in both samples such that the Middle and Far West occupied the highest position, New England and the Middle Atlantic states middle position, and the South the lowest position. Second, it proved possible to demonstrate a significant relation in both samples between the minimum cost of student attendance and the productiveness of the institution, such that institutions of high and low costs are inferior to those of average costs; in short, a parabolic relation obtains. In addition to these two general findings, it was possible to demonstrate among the universities a significant linear correlation between the ratio of faculty to students and our index. In a subsample of our liberal arts colleges, for which data were available, a significant linear correlation obtained between the median scholastic aptitude of the student body and the production of scientists. All other factors, including entrance requirements, proportion of Ph.D.s on the science faculty, mortality between freshman and senior year, etc., yielded no significant relationship.

Our interpretation of the two factors, geographic location and cost of attendance, which proved to be significantly related to the production of scientists in both samples, should probably be indicated. All attempts to resolve our geographic gradient by reference to other factors were futile, so that it appears to be intelligible only in terms of regional culture and regional vocational dispositions. Yet it is interesting to note in passing that those industrialized regions which offer the greatest vocational future to scientists are not the most productive, whereas the semiagrarian regions of the Middle and Far West produce most abundantly. The parabolic relation between cost of attendance and production of scientists seems best interpreted, especially in the light of our case studies, in the following manner: In institutions of very low costs, the quality of the education offered may be inferior, the student body ill-selected, and the faculty of poor preparation, thus making comparative failure entirely plausible. The inferiority of institutions of high cost, however, must be explained otherwise. Here, with superior selection of students, abundant material resources, faculties of distinction, and other seemingly propitious circumstances, the undistinguished trend seems primarily attributable to the nature of the student clientele. Our evidence indicates that high-cost institutions attract a relatively wealthy clientele who seldom pursue the economically unrewarding vocation of professional science.

Further prosecution of our inquiry involved the case study of 22 selected liberal arts colleges. It is not within the scope of this article to report on this phase of our study, though it may be indicated that this section of our inquiry has occupied the better half of our efforts. Here we have inquired into the characteristic stages of historical evolution of liberal arts colleges, the nature of departmental practices propitious to the development of scientists, the qualities and characteristics of eminent science teachers,

and into many aspects of curricular organization and collegiate administration.

The pertinence of our findings to the current scientific manpower problem of the nation needs little elaboration. In brief, they indicate clearly the very large and rather unexpected contributions made by small liberal arts colleges to the training of American scientists, and suggest clearly that the future of the scientific profession would be adversely affected by any policy that neglected their well-being. Scientists, to be sure, can be trained in other types of institutions, but only at a greater cost for a smaller yield.

Technical Papers

Observations on Radioactive Snows at Ann Arbor, Michigan

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Rigorous chemical separations performed on radioactivities found in snows around Ann Arbor, Michigan, after the Las Vegas atomic test explosions of January 27–February 6, have definitely established the presence of radioactive rare earth isotopes, barium and/or strontium isotopes, and have shown the possible presence of iodine isotopes.

Samples of snow for the experiments were taken from two sources several miles apart. The most definitive work was done on a snow pack one third to one half of which had fallen prior to January 31, and the remainder of which had fallen during January 31 and February 1. Samples included a complete cross section of the snow pack, as well as separate samples of the top and bottom halves. In all separations new glassware was used, and a "blank" run simultaneously to detect possible radioactive contaminants introduced by reagents, etc. The activities of the snow pack samples listed below are given as of midnight, February 4. Decay of the activities was followed from this date until February 21.

The snow samples were melted, and 10 mg of carriers of lanthanum, barium, and iodine added to 250-ml portions. Chemical separations were based on existing procedures for fission-product separations (*1*). Rare earths (including yttrium) were separated with the lanthanum by hydroxide precipitation followed by fluoride-hydroxide cycles and finally counted as the precipitated oxalate. Activities as high as 100 times background (30 cpm) were obtained in these rare earth fractions. The activity from samples of the cross section of the snow pack corresponded to about 9 dis/min/ml of melted snow, or about 60 dis/min/in.^{2} of snow sampled. These activities varied considerably with the locality of the sampling. From February 4 to February 21 the decay of the rare earth activity could be resolved into two components, one with a halflife of about 2 days, "tailing" into another with a halflife of about 12 days. Aluminum absorption curves of the longer-lived component indicated the presence of β particles of about 0.5 mev and 1.2 mev. Too little activity was available for further absorption data. These halflife and energy values are compatible with those of several of the more prominent rare earth fission products. The decay and absorption data of these rare earth fractions refute the possibility that this activity is due to naturally occurring radioactivities. Of the naturally occurring activities, only actinium would follow through the rare earth chemistry, and actinium isotopes would not show these observed characteristics.

The Ba-Sr fractions were separated by precipitation as the sulfate. These samples showed an activity about 5 times background at the time of separation. Within 4 days this activity increased by about 30%, due, undoubtedly, to the growth of the 40-hr La^{140} daughter of Ba^{140} and also to a small amount of the 65-hr Y^{90} daughter of Sr^{90}. After this initial increase in activity, the samples have decayed with a halflife of about 14 days.

Iodine in the –1 state was separated as the silver iodide. Samples of about half background were obtained, and these decayed with a halflife of about 8 days until accurate counts were no longer possible (about 6 days after separation). It is possible that this activity is due to the 8.0-day I^{131} remaining as a fission product in the –1 state.

The ratio of rare earth atoms to Ba-Sr atoms found in the snow pack corresponds roughly to what would be expected from a fission reaction. Although the distribution of fission products from an atomic explosion is undoubtedly somewhat different from that found in samples of uranium subjected to neutron irradiation in a nuclear reactor (*2*), this difference will probably not be significant (*3*). Hence, because of the chemical distribution of the activities found in the Ann Arbor snows, it can be stated that these activities undoubtedly originated in the Las Vegas atomic test explosions.

Experiments with samples taken from the bottom and the top of the snow pack indicated that the activity was concentrated in the top half of the snow—the portion that had fallen during January 31 and February 1. When portions of this top half were tested it was found that as much as 25 dis/min/ml of rare earth activity was present. Since atomic explosions were set off on the testing range near Las Vegas, Nev., on the mornings of January 27, 28, and

February 1, 2, and 6, it is evident that the activities in the snow must have come from the blasts of January 27 and/or January 28.

Subsequent snowfalls in Ann Arbor until February 11 were also checked for activity. Rare earth fractions from the snowfalls of February 6 showed very little activity, a maximum of about 1 dis/min/ml—approaching the limit of detection of our counting equipment. The activity of one other snowfall sample —that of February 4—was too near background to give evidence of isotopes in the rare earth region.

Many eastern localities have also reported the presence of radioactivity in their snows after the Las Vegas explosions. Although the activities reported in Ann Arbor in no way approach dangerous levels from a health standpoint, they could possibly become the source of contamination problems in such work as film packaging (*4*) or low-background radioactivity experiments.

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Electromigration in a Cation Exchange Resin[1]

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The exploration of the electrical conductance of ion exchange resins (*1–3*) and its dependence on the nature of the adsorbed ions suggest the study of electromigration in synthetic ion exchangers and the use of these resins for the separation of ions of different mobility. Electrical fields have been used to improve chromatographic separations (*4,5*) on cotton and siliceous materials and to effect separations on paper (*6,7*). Owing to the high capacity and great versatility of synthetic ion exchange resins, electromigration in these media is of special interest.

We followed the movement of ions in a resin column by use of the radiotracer technique. The experiments prove that the adsorbed cations carry the current. Thus, although solid in the physical sense, from the point of view of electrical conductivity the wet resins act similarly to solutions of electrolytes, confirming the hypothesis advanced to explain equilibrium experiments (*8*) that the resin phase is equivalent to an ionized salt solution.

An electric potential was applied to a resin column containing a layer of radioactive ions, and the movement of this layer along the column was observed. A Plexiglass electrolysis cell with perforated platinum electrodes was filled with Dowex-50[3] in the sodium form. A thin layer of active resin containing radiosodium was embedded in the resin column 3 cm from the anode. The activity at the beginning of the experiment and after passage of a constant current for a given time was measured by inserting the cell in a slide propelled by a screw under a Geiger-Mueller tube. This was mounted on a lead brick 9 cm high, covered with aluminum sheet to absorb most of the γ-radiation except for a narrow beam passing through the 3-mm slit cut in the brick under the tube. As different parts of the cell were exposed, the radiation emanating from each was recorded. The position of the tube could be read to an accuracy of 1/32 in. Voltage and current were measured at regular intervals, and a fast stream of deionized water (sp res, 10^6 ohm-cm) passed through the resin from anode to cathode in order to keep the resin temperature constant and to remove the sodium hydroxide formed at the cathode and the gases formed at both electrodes.

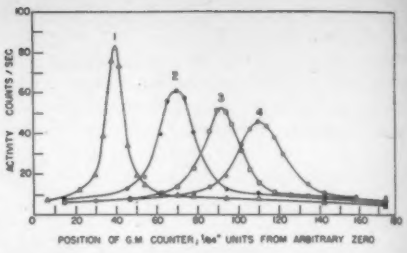

FIG. 1. Electrolysis of Dowex-50 in the sodium form traced with Na^{22}. Cell length, 9.8 cm; diam, 1.6 cm; resin mesh size, 80–100 (dry basis); current, 50 ma; tagged layer initially 3 cm from anode.
Curve 1, before applying the potential
" 2, after an electrolysis period of 3 hr
" 3, " " " " " 6 "
" 4, " " " " " 9 "

It had been verified that within a period equal to the length of the experiment only slight spreading of radioactive material occurs unless an electric potential is applied.

In different experiments, current and resin grain size were varied. The results of a typical experiment are given in Fig. 1, which shows a plot of the activity from a lamina of 2.6y Na^{22} tracer in the NaR, measured along the column at different times during the electrolysis.

The following electrode reactions were shown to occur:

Anode:
$$4R^- + 2H_2O = 4HR + O_2(g) + 4e^- \quad (1)$$
Cathode:
$$4e^- + 4NaR + 4H_2O = 4Na^+ + 4R^- + 4OH^- + 2H_2(g) \quad (2)$$

where R represents the resin radical.

As electrolysis proceeds, the hydrogen ions formed at the anode penetrate the whole sodium layer and

[1] This investigation was made possible by the Foreign Students Summer Project Program of the Massachusetts Institute of Technology and the Weizmann Institute Postdoctoral Fellowship. Support was also received from the Atomic Energy Commission.

[2] Weizmann Institute postdoctoral fellow at MIT.

[3] Furnished through the generosity of the Dow Chemical Company, Midland, Mich.

slow down its movement by virtue of competition by their higher mobility. They eventually reach the cathode. At this point the following reaction competes with reaction (2):

$$4e^- + 4HR = 4R^- + 2H_2(g) \qquad (3)$$

In the HR electrolysis reactions (1) and (3) there is no net production of the hydrogen form of the resin. Thus the yield of HR at the end of the electrolysis measures the extent to which the current is carried by sodium ions. For a total current of 252 and 1,140 mah (milliampere-hours) the yields varied between 100 and 67%, respectively, of the value to be expected if only reaction (2) occurred at the cathode.

At the beginning of the electrolysis the movement of the activity maximum is proportional to the current. The spread was found to increase with the particle size of the resin. In electrolyses where the slower ions follow the faster, sharp boundaries may be obtained. Thus when the system $Pt|NaR|ZnR_2|Zn$ is electrolyzed with the zinc and platinum electrodes as anode and cathode, respectively, metallic zinc dissolves in the resin and the boundary between the zinc and sodium resin remains sharp while moving toward the cathode, as shown by the results of an experiment in which the boundary was traced with 250d Zn^{65} (Fig. 2). In this case the displacement of the boundary from its original position is proportional to the electric charge passed, and practically only the following reaction occurs at the cathode:

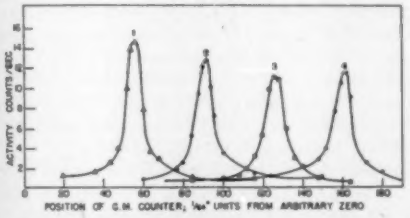

FIG. 2. Electrolysis of Na Dowex-50 and Zn Dowex-50 between platinum and zinc electrodes, respectively. Boundary between NaR and ZnR_2 traced with Zn^{65}. Cell, resin mesh size, and current as in Fig. 1. Traced layer initially 4.8 cm from anode. Activity corrected for room background. Designation of curves and time intervals as in Fig. 1.

$$2R^- + Zn = ZnR_2 + 2e^- \qquad (4)$$

The observed small flattening of the curves is probably due to the effects of diffusion, inhomogeneous packing of the column, temperature gradients, and in the case of the sodium resin also to the penetration of hydrogen ions.

The aspects of separations by resin electrolysis are different from those of regular chromatography, as both adsorption affinity and frictional resistance to ionic movement determine the movement of a band in an electric field, whereas in regular chromatography the mobility of the band is determined by the distribution of the adsorbate between solid and solution. In resin electrolysis there is no solution in the conventional sense unless the extensive ionic double-layer be considered as such. It is thus possible to induce band movement in the adsorbent column without its coming in contact with solution.

Apart from its possible application as a separation method, resin electrolysis may find use as a method for regenerating resins without using regenerant solutions; for instance, the conversion of the sodium into the hydrogen or zinc forms as shown in these experiments. Further studies are in progress.

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A New Electronic Apparatus for the Measurement of the Fusion Frequency of Flicker

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After introduction of the fusion frequency of flicker (fff) for the study of fatigue (*1*), anoxia (*2*), and various types of pathology (*3–6*), a rather large number of papers has appeared, and it is likely that this method will find rather general application in applied physiology and clinical medicine.

In the past the method has been applied in one standardized condition, which unfortunately differed in the investigations of various authors. It is highly desirable to provide for the variability of the brightness level, the visual angle, and the light: dark ratio, in order to test the effect of these fundamental variables on the response in physiological stress situations and to reproduce the testing conditions of other authors.

The classical experiments on the fff have been performed with rotating disks or cylinders with openings cutting a beam of light. An electronically produced and regulated flicker would have the advantage of freedom from vibration and noise and of a perfect square wave form of the light stimulus with a transition time not exceeding 1% of the cycle length.

The construction of the new apparatus was made possible by the recent development of a "glow modulator tube" (R1131A) by the Sylvania Electric Company for facsimile transmission (*7*). This tube emits, at maximum current flow, from a circular area of 3-mm diameter, a bright light of mixed white char-

[1] Now with Engineering Research Associates, Inc., St. Paul, Minn.

[2] Published with the approval of the chief medical director. The statement and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or the policy of the Veterans Administration.

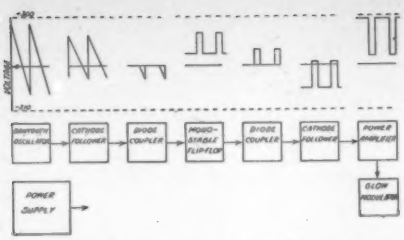

FIG. 1. Block diagram of the circuit with the resulting voltage wave forms at different stages of the circuit.

acter. The spectral emission curve is continuous, with a maximum at 5,100 A.

The electronic circuit is relatively simple in principle. First a saw-tooth voltage of the desired frequency is generated by means of a saw-tooth oscillator (Fig. 1). The oscillator is then coupled to a monostable multivibrator (commonly called a flip-flop circuit) in such a manner that the circuit is triggered when the voltage reaches a predetermined value as set by means of the time on-off control. Thus the flip-flop plate current will transfer at a given time and stay for the remainder of the period. By changing the trigger level or the d.c. component of the saw tooth, the flip-flop may be triggered at any time during the cycle, and the speed of transition may be made so short that square waves are generated. By this means the frequency, as well as the on-off proportion, may be varied. This flip-flop circuit is then coupled through a power amplifier to the glow modulator tube used as a light source. The brightness of the glow tube is regulated by limiting the current through the tube by means of a series resistance in the cathode circuit of the power amplifier.

Fig. 1 shows the functions of the various parts of the circuit and the voltage wave forms with reference to the power supply voltages. Fig. 2 shows the more

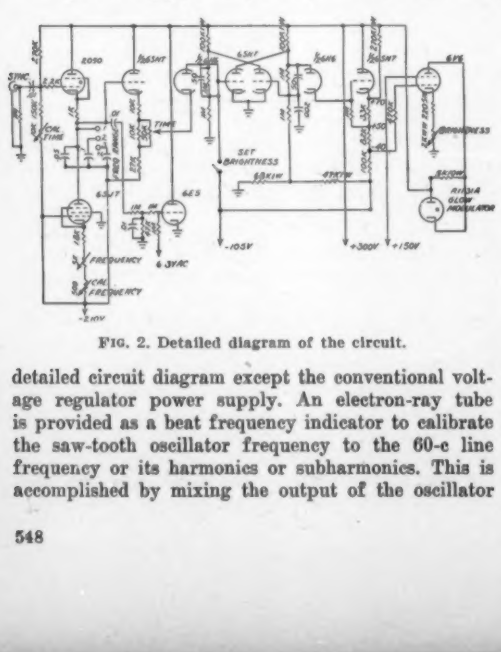

FIG. 2. Detailed diagram of the circuit.

detailed circuit diagram except the conventional voltage regulator power supply. An electron-ray tube is provided as a beat frequency indicator to calibrate the saw-tooth oscillator frequency to the 60-c line frequency or its harmonics or subharmonics. This is accomplished by mixing the output of the oscillator with the 60-c voltage obtained from the heater supply. The frequency range extends from 11.75 to 130 c but could be easily extended. Three continuous frequency ranges are provided for this purpose. For measurement of the fff the second range, extending from 20 c to 56 c, is most frequently used.

Three dials are provided for variation of the flicker rate, the light: dark ratio (from 20: 80 to 98: 2), and the brightness (by 15 times). The change of the brightness due to the change of the light: dark ratio can be compensated by changing the brightness dial, so that only one factor is varied at one time.

Calibration curves for constant brightness at different light: dark ratios were obtained for different light levels, using a G-E light-meter. Control measurements were made by means of subjective brightness comparison, using a flashlight bulb with a set of filters to make the brightness identical to that of the glow modulator tube. Readings of three observers gave identical values.

The color of the glow modulator tubes becomes reddish at low brightness. Although color does not affect the fff for the brightness range provided in this apparatus (*8*), for certain problems it might be preferable to vary the brightness by means of filters.

The scale of the frequency dial was calibrated by means of the scaling unit (Model 163) of the Nuclear Instrument and Chemical Corporation (Chicago), with an accuracy of 1/100 c. Before each experiment, the calibration is checked by setting the frequency dial at a rate corresponding to a harmonic or subharmonic of the power line frequency, and eliminating the beat in the electron-ray tube by means of a calibration dial. The calibration was found to be stable over a longer period of time.

The scale of the light: dark ratio dial was calibrated (1) by means of an audio-oscillator and oscilloscope, and (2) photometrically at high flicker frequency.

The glow modulator tube is housed in a wooden block. Two filters consisting of ground microscopic slides in front of the lamp give a sufficient and uniform diffusion on a circular test patch of 10-mm diameter, and reduction of light intensity to 150 ft-L, measured in front of the filter, at maximum current flow. A photographic shutter, operated by a 3-ft cable, is placed in front of the test patch, since a uniform exposure time is advantageous for the precise measurement of the fff. The exposure time can also be regulated by a switch in the glow modulator tube circuit. The shutter has the advantage of variability of the visual angle by using a set of lenses. The visual angle can also be varied by changing the distance between eye and light source.

The tube is clamped in a conventional laboratory stand, and can be adjusted to any desired angle. It can therefore be easily used at the bedside, with the patient in a reclining position. The tube can also be clamped on a perimeter for flicker perimetry. The view of the dials may be concealed from the patient during the test; in fact, the cabinet with the dials can be operated from another room.

The apparatus can be built at a cost below the

price of commercially available models, which provide, as a rule, only one testing condition. The device may also be used as a square wave stimulus generator, for nerve and muscle physiology, replacing the glow modulator tube by coupling capacitor and potentiometer to chassis ground.

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A Method for Preparing Slide Mounts of Small Invertebrates

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For some years the writers have been working on methods of mounting insects and other small invertebrates on slides for permanent preservation. Basically the procedure finally adopted follows that suggested by Middlekauff (*1*), but several major modifications have been made to adapt it to different needs. Furthermore, the method here presented has been found excellent for mounting both immature and adult insects, as well as other arthropods, helminths, and so on.

Adult insects are collected in 95% ethyl alcohol. Soft-bodied stages that are subject to shrinkage and discoloration are collected in a killing fluid recommended by Alvah Peterson and composed of 95% ethyl alcohol, 10 parts; glacial acetic acid, 2 parts; kerosene, 1 part; and dioxane, 1 part. Larvae should be kept in the solution until properly distended and then placed in 95% ethyl alcohol. For most adults, no special killing fluid is necessary or even desirable. It is important to note, however, that in many instances, color features may be preserved by mounting immediately after collecting. This is true, for example, of some greens in adult midges, which ordinarily fade considerably. Helminths fixed by usual laboratory methods can be washed and stored in 95% ethyl alcohol. Formalin-preserved specimens must be washed carefully and carried up to 95% alcohol before utilizing this method.

To prepare specimens, use three 5-ml beakers containing 95% alcohol, absolute alcohol, and beechwood creosote, respectively. Total volume of the specimens processed should not exceed about 10% of the volume of the fluid. Specimens are left in 95% alcohol a few minutes, in absolute alcohol at least a minute, and then transferred to creosote, where they invariably float; they should be retained in it until they sink to the bottom of the beaker. This may take 10 min or longer. Specimens may be kept in the creosote indefinitely without apparent harm. Ticks, other arthropods, and helminths have been stored in creosote for 12–15 months prior to their preparation as permanent mounts. After several hours in the creosote, specimens may be mounted whether they sink or not, although failure to sink is usually indicative of the presence of air spaces in the specimen, and such specimens are not likely to make the best mounts. Some nematodes require an immersion in a fourth 5-ml beaker containing an equal mixture of beechwood creosote and diaphane, to facilitate the penetration of the mounting medium into the body spaces of the specimens. Before transferring specimens to a glass slide, a drop of diaphane is placed on the slide. Specimens are moved from the creosote to the diaphane droplet, covered with more diaphane, and then covered with a cover slip. Mounts should be examined daily, and diaphane added until air spaces cease to develop under the cover slip.

If specimens are thick enough to cause a noticeable tilting of the cover slip, clear celluloid or plastic supports, about 3 × 6 mm, may be placed on the slide so as to hold the cover slip in a perfectly horizontal position. If materials of several different thicknesses are available, the correct thickness may be selected for the specimen at hand, but very thin supports may be used for all purposes by creasing them across the middle. Such creased supports have a desirable degree of springiness.

Perhaps the principal advantages of the method here described are its simplicity and broad applicability.

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Roentgen Irradiation of Para-aminobenzoic Acid Solutions

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Recent progress in radiation therapy of neoplastic diseases has focused attention on the radiation chemistry of the action of ionizing radiations on aqueous solutions of biologically significant organic compounds (*1*). Studies on certain amino acids, vitamins, enzymes, nucleotides, proteins, and steroids have already been reported. Dosages of radiations, however, were much greater than those therapeutically employed, whereas concentrations of solutions used were generally much higher than those obtained under physiological or therapeutic conditions. Studies under conditions more closely approximating those found clinically may yet prove steppingstones to the

[1] Now at Institute of Tropical Medicine, The Bowman Gray School of Medicine, Winston-Salem, N. C.

elucidation of the chemotherapeutic action of these radiations on neoplastic tissues.

During the past decade or so, *p*-aminobenzoic acid (PABA) and its derivatives have occupied the limelight in the field of chemotherapy. Certain clinical observations indicate an intimate relationship between the pharmacological action of these compounds and their radiochemical behavior. Patients receiving combined sulfonamide and x-ray therapy often suffer severe reactions not produced if either treatment is given separately (*2,3*). One of us (I.C.C.T.) has previously shown that certain sulfonamides are broken down *in vitro* by x-irradiation (*4,5*). These breakdown products have not yet been identified but may play a part in such toxic reactions. On the other hand, PABA, the mother substance of these compounds, has been used to counteract the effects of solar irradiations (*6,7*). It has been our experience that, by combining PABA with x-ray therapy, a more potent effect from the radiation on malignant growths is obtained than if x-rays are used alone. Hematological observations indicate a probable relationship with folic acid (unpublished results). These interesting observations, together with the fact that no reference can be found to any investigation on the radiation chemistry of PABA and its derivatives (other than the above-mentioned preliminary report), prompted a reinvestigation of the study interrupted by the war. Preliminary results are reported here.

Stock millimolar solutions of PABA[1] were prepared fresh each week, and dilutions made up therefrom immediately before use. Triple-distilled water was employed for all solutions. Matched Pyrex test tubes (20 × 150 mm, wall thickness, *ca* 1 mm), each containing 25 ml PABA solution, were irradiated in batches of 16 tubes arranged in 4 rows, each 4 tubes deep, and held in place by a square wooden holder. All tubes were uncorked during irradiation.

Preliminary trials made with a 400-kv G-E maximar machine yielded irregular results. Data reported hereunder were obtained with a 250-kv constant-potential Westinghouse therapy machine at 230 kv, 15 ma, with no added filter and with the front of the test-tube holder 22 cm from the target. The time of irradiation was controlled by an automatic timer, and dosages received by each tube were measured with a Victoreen condenser r-meter.

Immediately after irradiation, the amount of PABA remaining in solution was estimated in triplicate on 2.0-ml samples taken from each tube. A modified Bratton-Marshall's test (*8*) was followed, using *N*(1-naphthyl-)ethylenediamine hydrochloride as coupling agent, and the resulting color was estimated on a Beckman DU spectrophotometer at wavelength 535 mμ.

Fig. 1 summarizes graphically the data obtained for three series of experiments with solutions containing 10 mμM (1.37γ)/ml. Percentages of PABA

[1] We are indebted to Merck & Co., Inc., Rahway, N. J., for a generous supply of especially purified crystals of PABA for these experiments.

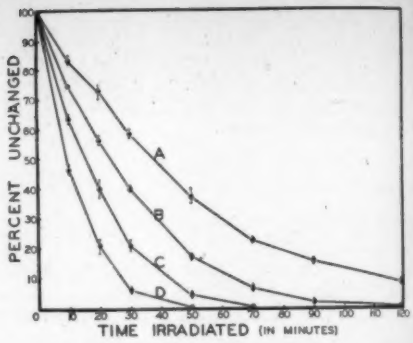

FIG. 1. X-irradiation of *p*-aminobenzoic acid, showing percentage unchanged in 25 ml aqueous solution (10 mμM/ml) at dosage rates of curve *A* 400 r/min, *B* 640 r/min, *C* 1,000 r/min, and *D* 1,650 r/min.

unchanged are plotted against their respective period of irradiation. The time factor is used, since accurate measurement of the actual dosages received in terms of roentgens was not possible, because of intensity of irradiation—the time for discharge of the meter was so short (10 sec) that accurate readings could not be made. The dosages listed under the caption of Fig. 1 represent the average of these readings from the 4 tubes in each row parallel to the axis of the x-ray tube. Curve *D* represents the rate of destruction of PABA in the front row of tubes, Curve *C* the second, etc. With solutions of higher concentrations (50–100 mμM/ml), similar curves were obtained—the higher the concentration the flatter the curve. Lower concentrations were not studied, since they do not lend themselves to chemical estimation by the Marshall test.

Since the characteristic color of Marshall's test is developed only in the presence of a free amino group attached to the benzene nucleus, the test is at least a measure of the cleavage of the amino group from the parent compound and, therefore, a gauge of the destruction of the PABA molecule. Browning of the solutions was noticed, but no precipitate was obtained, even on long standing. A saturated solution on prolonged irradiation yielded a small amount of brown precipitate, the nature of which has not yet been determined. Ultraviolet absorption curves of solutions irradiated for varying lengths of time yielded only the characteristic PABA curve, with the longer the time of irradiation, the flatter the curve. Solutions giving a negative Marshall's test exhibited no absorption in the ultraviolet.

It will be seen that PABA at dilutions approximating those usually found under physiological and therapeutic conditions in human tissues is destroyed by x-irradiation in an exponential manner. This verifies the preliminary observation made by one of us (I.C.C.T.) in a former paper (*4*). We have not been able to determine what chemical change took place in the PABA molecule on irradiation. Microchemical and spectrochemical studies on the products of the

reaction have so far yielded inconclusive results, probably because of the high dilutions employed. Further studies are in progress, following the recent reports of Weiss *et al.* (*9*), which appeared while the present study was being carried out.

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The Decrease of Critical Flicker Frequency with Age

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The perception of flicker and fusion is one of the most interesting visual phenomena. In recent years considerable interest has been shown in the measurements of critical flicker frequency (cff), which have been used in many studies. Therefore, knowledge of all the factors determining cff has become of great theoretical and practical importance. A number of investigators have pointed out age as a factor in cff. Some investigators, such as Meili and Tobler (*1*), G. W. Hartmann (*2*), and V. L. Miller (*3*), comparing different age groups of children and young adults over a relatively narrow age range, have not found any change in cff with age. Investigators who studied larger age ranges, however, such as Simonson, Enzer, and Blankstein (*4*), Brožek and Keys (*5*), Weekers (*6*), and Misiak (*7*), reported a significant decrease in cff in older age groups. The results of their investigations have not been conclusive because:

1. They were based on relatively small numbers of Ss.
2. They failed in having a sufficiently wide age range.
3. The results were not comparable, since they were obtained by different methods.

From these studies nothing definite could be inferred concerning the form, extent, and cause of the decrease of cff with age. Thus it was thought to be of value to measure cff of sufficiently representative samples over a large age range, using the same apparatus and procedure throughout the study.[1]

The subjects were 182 males and 137 females free from any visual pathology, ranging from 7 to 89 years of age, with a mean age of 36 years. After the completion of the study, they were divided into 17 five-year groups and their cff's and variability compared.

With a few minor changes, the apparatus used in this study was built from the specifications and data presented in an article by F. Henry (*8*). It was an electronic apparatus which had a 3-w neon glow lamp giving an intermittent light at a rate determined by 3 adjustable resistors. Another neon lamp, similar to the lamp producing the flicker, served as a voltage regulator, thus assuring the constancy of the flicker rate, even if the supply voltage varied. A small cathode-ray oscilloscope tube built into the apparatus permitted its calibration. The circular test patch was 5 mm in diameter. From a distance of 12.8 in. the subtending visual angle was 48 min, assuring foveal observation of flicker when the eyes were fixated on the test patch.

All the Ss were adapted to the illumination level of the light source of the flicker apparatus before they were tested for cff. The observations were made with the dominant eye. The frequency of light flashes was gradually increased until the subject reported no flicker, and the frequency was then decreased until the flicker was again seen. The cff value of each S was the mean of the readings obtained from flicker to fusion and from fusion to flicker, which numbered 20 on the average. In the early stage of the research, Ss were tested for 10 days with the number of readings ranging as high as 80, but when no significant day-to-day changes were found, and the correlation coefficient between readings obtained on successive days was above .95, the number of readings was reduced.

The group results are presented in Table 1. The mean cff under the experimental conditions of the study was 41.18 cps for the males, 41.08 for the

TABLE 1

Means and Variability of Critical Flicker Frequencies for Different Age Groups

Age groups	N	Cff	Inter-individual variability SD	Intra-individual variability AD
7–11	35	42.91	4.31	.90
12–16	36	44.85	4.36	.71
17–21	39	43.63	3.54	.58
22–26	39	42.62	3.86	.83
27–31	16	42.65	3.51	.62
32–36	26	40.86	3.64	.79
37–41	18	40.27	4.07	.74
42–46	14	40.42	3.98	.92
47–51	18	39.46	3.90	.75
52–56	13	40.99	6.15	.60
57–61	12	38.38	3.42	.77
62–66	5	36.06	2.10	.35
67–71	14	38.91	5.46	.35
72–76	13	36.41	3.81	.33
77–81	13	32.22	6.25	.36
82–86	6	35.82	5.69	.37
87–91	2	36.04	3.61	.47
Total	319			
Mean		41.14	4.22	.68

[1] This undertaking was carried out through the help of I. McCormick, J. Doblmeier, and W. McGill, of Fordham University, who made their results available to the author and to whom he expresses his thanks and appreciation.

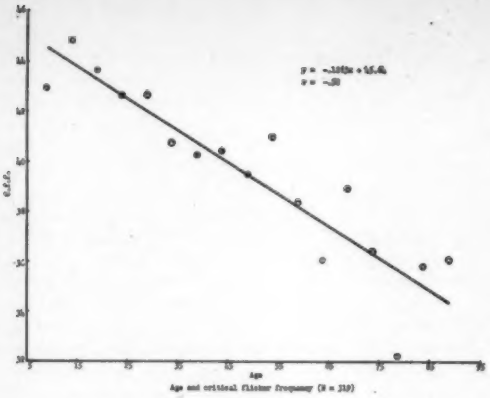

FIG. 1.

females. The mean cff for the youngest group (7-11) was 42.91, for the oldest (87–91) 36.04. The striking fact about these cff's is the large range of individual measures of 37.35 cps (18.29–55.64) and the great variability of 4.22 of the total group. In addition, there was appreciable interindividual variability within the age groups. No significant sex differences were found. The relationship between age and cff is linear and negative, the correlation coefficient, based on all individual cases, being significant but small –.52 (Fig. 1). The differences between groups are statistically insignificant, except between the groups below 30 and above 55 years of age. Thus it can be concluded that cff drops with age, this drop becoming significant in individuals later in life (after 55). However, it must be pointed out that there were cff's at age 82 as high as at age 7, and on the other hand there were cff's at age 7 as low as at age 80.

The interindividual variability tends to increase with age, a tendency generally characteristic of many mental and physical capacities. The intraindividual variability, on the contrary, shows tendency to decrease.

There is a strong indication, however, from other investigations still in progress that the relationship between cff and age differs with intensities of light, the higher the intensities the greater the slope of the line expressing this relationship.

The cause of the decrease of cff with age is hard to understand. It may lie in peripheral factors (the retina), or in central factors (subcortical or cortical), or both. A Belgian investigator, Weekers (*6*), has suggested that smaller diameter of pupil and its diminished mobility in old age may be the cause of lower cff. When he used mydriatics in his subjects, he did not find any change in cff until after 50 years of age. It is true that the iris becomes thinner and more rigid with age, and that the pupil becomes smaller and less mobile, but the present investigator does not feel that this is the sole explanation for the lower cff, especially in view of the gradual decrease of cff even before the age of a diminished mobility of the pupil, and in view of the fact that injuries of the cerebrum lower cff (*9*). The pupil factor seems to be, nevertheless, an important one. In another study (*10*), using a different apparatus with lower intensity of the flickering light, we found difference in cff between groups 20–30 and 40–50 (32.00 and 31.16, respectively), but when artificial pupils were used the cff for both groups was almost identical (24). It is possible that the key to the solution of the decrease of cff when no artificial pupils or any drugs affecting the pupil are used lies in the relationship between the sympathetic and parasympathetic systems with regard to the pupil. If the parasympathetic system becomes more dominant with age, the fact that the light reflex is more pronounced would result in the diminished diameter of the pupil, in turn lowering the retinal illumination and consequently also the cff. That is why higher intensities of flickering light would show greater differences in cff with age than lower intensities. We intend to investigate this hypothesis by further experiments.

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A Nomogram for the Calculation of Relative Centrifugal Force

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It is well known that the centrifugal force developed in a rotating system is proportional to both the radius and the square of the frequency of revolution. Nevertheless, many experiments in which centrifugal separation is an important procedure are reported merely in terms of "revolutions per minute" (rpm). Results, so reported, are of little quantitative significance. Therefore, when the rate of sedimentation is of importance, as in centrifugal fractionation, or when the volume of the sediment is measured, a more complete specification should be provided.

A convenient measure of centrifugal force is given by the ratio of the weight of a mass in the centrifugal field to the weight of the same mass when acted upon by gravity alone. This relative centrifugal force, G, is proportional to the absolute force applied to a suspended particle and, therefore, also is proportional to the speed of free sedimentation in a wide variety of

systems. When it is permissible to neglect the increase of G along the tube, the system may be characterized by a single value; a satisfactory convention is the specification of the value of G which prevailed at the bottom of the tube, since this maximum value (G_{max}), unlike the minimum or the average value, is independent of the height of the fluid level in the tube.

Time may be incorporated into the description by forming the product $G_{max} \times$ min to give a single datum which is adequate for the specification of many procedures. When required, this datum should be supplemented by calculation of the force gradient along the tube and by description of special geometrical features such as the degree of angulation of the tube in relation to the axis of rotation.

The necessary calculations of relative centrifugal force, G, from the *Radius* and the rpm are facilitated by the accompanying nomogram (Fig. 1). A thread

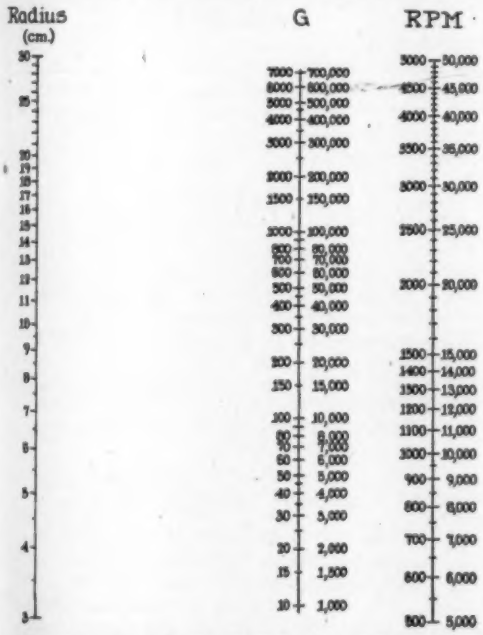

FIG. 1. Nomogram for the calculation of centrifugal force.

stretched across the chart so as to intercept the scales of any two variables at selected values will cross the third scale at a value which satisfies the equation $G = 1.11 \times 10^{-5}\ (R) \times (\text{rpm})^2$. It should be noted that the chart can be used for the calculation of values outside the indicated ranges merely by proper shifts of the decimal points since a change in *Radius* by a factor of 10 alters G to the same extent, and a change in rpm by a factor of 10 affects G by a factor of 100.

Use of this nomogram in our laboratory has improved the planning of centrifugal fractionations in which the proper choices of rotor head, speed, and time are required for efficient separation. With its use there has developed the habit of thinking directly in terms of the forces at work rather than in terms of a partial datum (rpm) which happens to appear on a dial at the top of the instrument.

A Laboratory Method for Evaluating the Phytotoxicity or Phytostimulation of Insecticides[1]

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Since the advent of numerous synthetic organic insecticides, particularly the chlorinated hydrocarbons, for the control of insects affecting plants, there has been an increasing need for a rapid laboratory technique to estimate relative phytotoxicity of these compounds. As it has been shown by Chapman and Allen (*1*) that DDT stimulates plant growth, the technique should also be adaptable to measuring possible plant stimulation by the insecticide. The methods currently employed for phytotoxicity studies are based largely on gross expression of plant damage when plants are grown under field or greenhouse conditions. Such methods have proved to be time-consuming and have yielded only qualitative relationships. The procedure reported here is both rapid and quantitative in nature.

Methods initially tested for possible adaptability in measuring phytotoxicities were based on the techniques that have been used in the detection of plant auxins. The *Avena* coleoptile test (*2*) and the slit pea stem test (*2*) proved inadequate. A modification of the slit pea stem test, using the pole bean or cucumber, proved usable but did not allow a distinction between phytotoxicity and growth stimulation. Growth of cucumber roots was found very sensitive and was used to a large extent; the principal difficulty, however, was in the interpretation of growth inhibition, since stimulatory (auxins) as well as inhibitory substances to aerial parts of the plant cause root inhibition. Respiration and permeability tests were discarded because the various compounds to be tested varied in their mode of action. Of the different procedures tested, it was found that readily interpretable and consistent results could be obtained by the use of the straight growth of stem sections of the Kentucky Wonder pole bean grown under standardized conditions in a nutrient solution.

Pole bean seeds from a uniform standard lot were immersed in water for 1 hr and planted in moist Vermiculite[2] in darkness and held at a temperature of 23°–26° C. At 7 days the plants have developed a long hypocotyl and the epicotyl is just ready to emerge. Plants selected for testing are taken from those in which the epicotyl has not yet emerged and

[1] Approved for publication by the director of the Wisconsin Agricultural Experiment Station.

[2] Expanded mica used commercially for insulation.

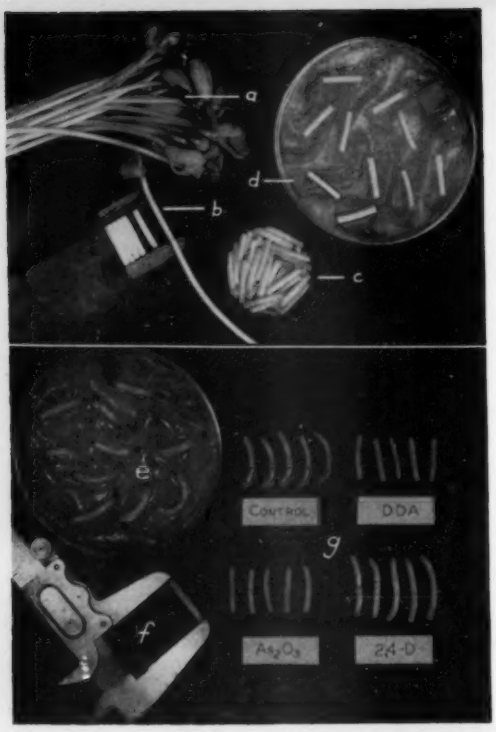

FIG. 1. Procedure for testing straight growth of bean stem sections. A uniform lot of bean seedlings (*a*) is cut (*b*) until sufficient sections are collected (*c*) to place in Petri dish (*d*) with toxicant. After 48 hr the sections (*e*) are measured (*f*), and the differences compared with the control and standard As_2O_3 and 2,4-D (*g*). (DDA at $1 \times 10^{-3} M$; As_2O_3 at $1 \times 10^{-3} M$; 2,4-D at $1 \times 10^{-4} M$.)

which range in height from 10–20 cm. Particularly slender or robust seedlings are discarded. A 20.0-mm section is removed from the hypocotyl of each plant beginning at a point 1 cm below the node at which the cotyledons are attached. A cutter consisting of 2 razor blades permanently mounted 20.0 mm apart in a wooden handle is convenient for removing the sections.

Serial dilutions of the substance to be tested are prepared in a nutrient solution of 0.5 mg/l IAA (indole-3-acetic acid) and 1% sucrose, a volume of 40 ml being convenient. The pH is critical, and in those cases where any constituent might alter it, the solution should be adjusted to pH 6.0 and buffered with pH 6.0 $M/40$ phosphate buffer.

Glass wool is added to the dishes to support the plant sections so that air as well as the solution is accessible. After the addition of the glass wool, 10 sections of plant material are placed in each Petri dish. At this point insoluble materials may be applied directly to the surface of the sections, or the sections may be variously exposed to dusts or sprays. The Petri dish is then covered and kept in darkness for 30–48 hr to allow the sections to grow. At the end of 30 hr, when plant growth is essentially completed, the lengths of the sections are either measured directly with a vernier caliper or interpreted by shadowgraphs. Curvatures developed during growth may be useful when making comparisons but do not interfere with the accuracy in measuring the length of sections. Observations may be taken as convenient up to 48 hr, but extended holding of the plants may result in interference by yeasts and molds. The authors have tested each treatment in duplicate series. The procedure is illustrated in Fig. 1.

Comparisons of different treatments are conveniently made on the basis of percentage inhibition of growth, or the "phytotoxic index." By the term "phytotoxic index" is meant the measure of differences or percentage of inhibition of growth expressed as

$$100 \left(\frac{\text{elongation in control} - \text{elongation in treatment}}{\text{elongation in control}} \right).$$

Standards employed for comparing the degree of phytotoxicity or stimulation are arsenic trioxide and 2,4-D, both of which are available in high purities. Fig. 2 illustrates the relative action of these standards as compared with that of DDA (dichlorodiphenyl acetic acid), an analog of DDT (dichlorodiphenyl trichloroethane).

This method has been used to compare the relative phytotoxicity or phytostimulation of a large series of new organic insecticides, as well as their impurities and breakdown products. It has also been found useful in comparing the effect of different methods of insecticide application on phytotoxicity. The results of these studies are to be presented in detail in a forthcoming publication.

By this technique further information can be obtained relative to the mode of phytotoxic action of insecticides, as has been recently reported with other growth inhibitors (*3, 4*) by a somewhat similar method. Because of variance in susceptibility of plant species to insecticides (*1*), this method has been

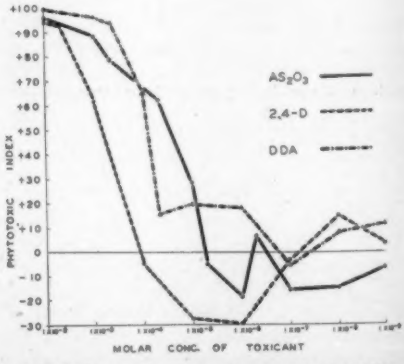

FIG. 2. Relative action of arsenic trioxide, 2,4-dichlorophenoxy-acetic acid, and dichlorodiphenyl acetic acid in inhibiting the growth of bean stem sections.

adapted for use with a series of different plants, but is only illustrated here with the bean. The results with this technique are not directly interpretable to conditions other than those actually tested. However, this procedure allows a rapid laboratory screening technique to test for both stimulatory or inhibitory effects of chemicals.

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Excretion of Gallium by the Rat and by Man[1]

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Dudley (*1–3*), working with rats, dogs, rabbits, and goats, found the principal route of excretion of gallium to be the kidney. Confirmation of this has been noted in previous reports (*4, 5*). The purpose of this report is to detail the comparative excretion of gallium in the rat following intravenous administration of (1) $GaCl_3$, a rapidly ionizing salt, prepared by dissolving irradiated $Ga(NO_3)_3$ in HCl and then neutralizing with NaOH to a pH of 2.2; (2) the slowly ionizing complex, gallium citrate, which was prepared in an ion exchange column and stabilized at pH 7.0 with sodium citrate (*6*). A second comparison is made between the excretion by the rat and by man of tracer and larger intravenous doses of gallium citrate prepared according to a method described by Dudley (*7*).

Procedures. The rats, young adult Wistar-strain males weighing 275 ± 25 g, were injected via the tail vein. One of the human subjects had multiple myeloma, one had osteogenic sarcoma, and one had Hodgkin's disease, but all three were considered essentially normal from the standpoint of excretory mechanisms. Other details, such as care of the animals, collection techniques, tissue sampling, and counting procedures, have been described previously (*5*). In performing the $GaCl_3$ studies, 5 rats were sacrificed at 6, 12, 48, and 96 hr and 4 at 24 hr following injection. For the citrate study, 4 rats were sacrificed at 12, 24, 48, 72, and 96 hr after injection. Depending upon the time of sacrifice, the rats received between 200 and 300 μc of Ga^{72} in 1.5–2 mg of stable gallium. The patients received the mc doses noted in Table 1 of the gallium citrate preparations, which had a specific activity of about 1 mc/5 mg of gallium. In all instances, the urine and feces were collected with negligible or no cross-contamination (*8*).

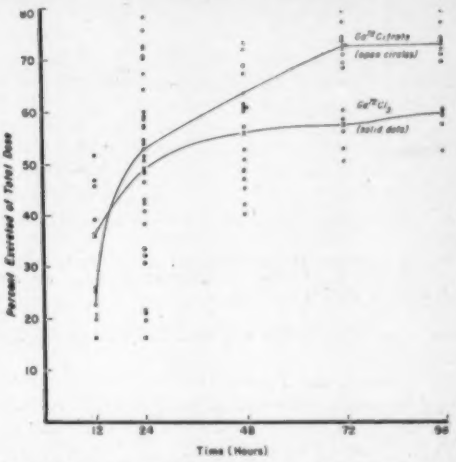

FIG. 1. Urinary excretion by the rat of intravenously injected Ga^{72}, expressed in terms of percentage of total dose excreted as a function of time in hours.

The data have been corrected for radioactive decay to the time of injection.

Results. Fig. 1 indicates the variation from animal to animal of the fraction of the administered dose recovered from the urine. However, the arithmetical

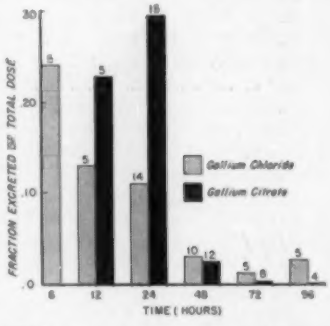

FIG. 2. Daily urinary excretion rate of gallium; average of the fractions of total recovered dose during the periods indicated. The numbers above each bar indicate the number of samples.

average and the median values check each other closely, so that the lines, as drawn, picture a reasonable central tendency. Thus, about 73% of the gallium administered as the citrate was excreted by the fourth day compared with 59% for the chloride salt. In Fig. 2 the excretion is drawn on a nonaccumulative basis to show that during the first 6 hr gallium as the chloride is excreted more rapidly, and also to demonstrate the fact that its subsequent excretion rate is lower than that of the citrate. Essentially all the gal-

[1] Gallium used in the study was furnished by Comdr. H. C. Dudley (MSC), USN, of NMRI, Bethesda, Md.

[2] Comdr. (MC) USN. The opinions or conclusions contained in this report are those of the authors. They are not to be construed as necessarily reflecting the views or endorsement of the Navy Department.

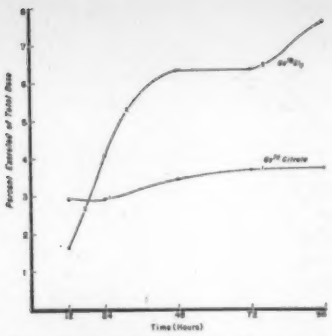

FIG. 3. Fecal excretion by the rat of intravenously injected Ga^{72}, expressed in terms of percentage of total dose excreted as a function of time in hours.

lium as gallium citrate was excreted during the first 3 days.

In contrast, the fecal excretion (Fig. 3) of the $GaCl_3$ was about twice that of the citrate salt. At 96 hr the urine/feces ratio was about 8 for the chloride salt and 19.3 for the citrate complex.

The curves of decrease of gallium radioactivity in the rats (Fig. 4) were constructed by subtracting the cumulative urinary and fecal excretion from the total recovered activity and normalizing these to 100%. By chance both curves intersect the 50% excretion level at about 20 hr, which time is termed the biological half-life. The physical half-life of Ga^{72} is 14.3 hr and is plotted to the same scale for comparison.

In man the chief route of excretion is also the urinary tract. In Table 1, which shows the 96-hr cumulative excretion in the urine of 3 patients, it appears that the excretion of gallium was affected by the size of dose of the stable metal. The shape of the curves of excretion is roughly exponential, as in Figs. 1 and 4. The fecal excretion in these human cases was less than 1% of the total dose administered. A biological half-life similar to that in Fig. 4 can be given only provisionally as about 100 hr. This uncertainty arises because the number of subjects is limited, and variations probably exist in the rate of excretion relative to the dose of the metal. This point is under intensive investigation.

The biological and physical half-life values, because they are used in isotope radiation tissue dose formulas, are of particular importance for all isotope studies. Generally they are combined into a factor termed the "effective half-life," defined as the ratio of the product of the physical and biological half-lives to their sum (*9*). This "effective half-life" relates to the over-all decline and has no bearing on changes in concentration in specific tissues. The latter can vary independently of the total effective half-life and is the significant factor in computing therapeutic tissue doses. In the rat studies, the effective half-life at that dose level was 8.33 hr (Fig. 4). This value for the larger doses in man was calculated to be about 12.5 hr; the slower rate of excretion of the tracer doses

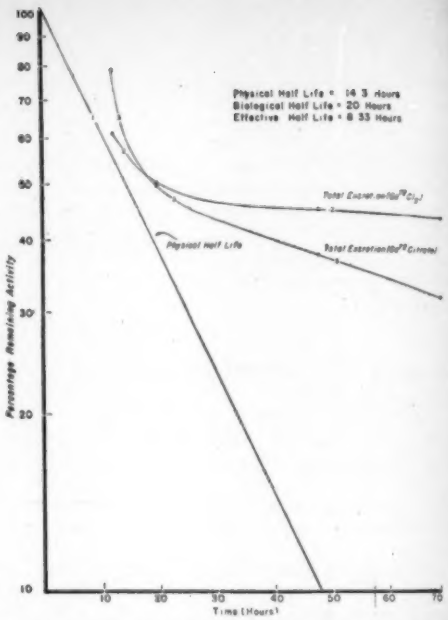
Physical Half Life = 14 3 Hours
Biological Half Life = 20 Hours
Effective Half Life = 8 33 Hours
Physical Half Life
Percentage Remaining Activity
Time (Hours)

FIG. 4. Curves showing amount of intravenously injected $Ga^{72}Cl_3$ and gallium 72 citrate remaining in the rat compared with the curve of the physical half-life of this Ga^{72}.

would lengthen the effective half-life insignificantly because of the short physical half-life.

The difference between the excretion patterns in rat urine of the two forms of gallium is probably real. The chloride has a pH of 2.2, ionizes readily, precipitates proteins, including plasma protein, and forms colloidal aggregates at pH 7.4. The citrate

TABLE 1

URINARY EXCRETION OF GALLIUM BY THE HUMAN

Patient No.	Diagnosis	Isotope dose		Metal dose		Percentage of initial dose excreted in 96 hr
		mc	mc/kg	mg	mg/kg	
1	Osteogenic sarcoma	1.00	—	5	—	26
		22.5	0.86	90	2.81	47
		52.0	1.62	185	5.75	40
		46.3	1.45	180	5.60	46
		49.0	1.53	166	5.19	40
2	Multiple myeloma	1.00	—	5	—	6
		8.00	0.14	105	1.90	18
		49.90	0.92	166	3.07	22
3	Hodgkin's disease	1.00	—	5	—	37
		20.00	0.34	107	1.78	37
		51.50	0.83	200	3.33	48

complex, on the other hand, is stable at pH 7.0 and does not precipitate proteins, but probably exists as a fine colloid or aggregate. Under these circumstances it would be unusual if these two forms were handled by the body in the same manner and/or at the same rate.

A distinct species difference is present relative to this metal. The rat, for example, tolerates some 10 times more gallium citrate than the dog, according to studies in progress. Man probably fits somewhere between these two species.

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Inhibitory Action of Adrenalin on Growth of Rat Sarcoma[1]

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In an earlier study (*1*) it was found that tumor tissue, when minced with adrenal gland prior to implantation into susceptible rats, failed to grow because of some substance present in the gland. The inhibition of the growth of tumor grafts took place regardless of whether the adrenals were obtained from normal, tumor-bearing, or tumor-immune rats. The present study is concerned with the action of one of the hormones of the adrenal gland—namely, adrenalin—on the growth of tumor tissue.

The adrenalin used was in the form of a sterile solution containing 1 mg of epinephrine in 1 ml of sterile physiological salt solution to which 0.1% sodium bisulfite and 0.5% chloretone[3] were added as preservatives.

Rats of the Lewis and King A inbred albino strains, and native tumors that were 100% transplantable in rats of their own strain, were used.

Four types of experimental procedure were utilized: Implantation of minced viable tumor tissue to which solutions of adrenalin had been added; intratumoral injections of solutions of adrenalin; injections of adrenalin around small tumors growing in susceptible rats; and injections of adrenalin into the subcutaneous tissue 2–3 hr, 3 days, 7 days, and 10 days prior to implantations of tumor grafts into the same site.

Control experiments were carried out using additions of physiological salt solution, of 0.1% sodium bisulfite, and of 0.5% chloretone in place of adrenalin with the minced tumor tissue implanted into susceptible rats.

The results showed that additions of adrenalin (½ ml to 2–3 ml saline) to equal parts of minced tumor tissue inhibited its growth in 13 of the 25 rats that survived an injection of 2 ml of the suspensions. In some instances the grafts grew to some extent, but this initial growth soon regressed. The addition of physiological salt solution or of 0.1% sodium bisulfite in saline to minced tumor tissue did not inhibit the growth of the tumor tissue, but the addition of solutions containing 0.5% chloretone prevented the growth of the tumor cells.

All the rats in which tumors were injected with adrenalin diluted with salt solution died within 24 hr. When aqueous solutions were injected intratumorally the majority of the treated rats survived. Thirty-four rats in which tumor grafts had grown for 6 days were given 8–12 intratumoral injections, at 3-day intervals, of ½–1 ml of adrenalin diluted in 1 ml sterile distilled water. They exhibited the type of damage that takes place when growing tumors are treated with extracts prepared from tumor by means of 95% alcohol, and that results in oncolysis and development of tumor-immunity in 100% of the treated rats (*2, 3*). The treatment with adrenalin, however, resulted in absorption of tumors in only 20 of the treated rats; of the other 14 rats, 9 died from adrenalin; in 5 rats, the tumors continued to grow.

Injections of adrenalin around growing tumors resulted in death of the majority of the treated rats. Atrophy and absorption of tumors, however, did take place in 7 of the 22 treated rats that survived.

The results brought about by injections of adrenalin into the subcutaneous tissue of a given region prior to implantation of tumor grafts depended upon the interval of time allowed to elapse between the injection of adrenalin and the implantation of the grafts. The grafts failed to grow in 21 of the 34 rats that were engrafted 2–3 hours after the injections of adrenalin; on the other hand, they grew in 5 of the 13 rats following a lapse of 3 days; in 6 of the 9 rats after a lapse of 7 days, and in every one of the 11 rats engrafted 10 days after the subcutaneous injections of adrenalin.

All the rats in which tumors were absorbed, as well as those in which tumor grafts failed to grow, were implanted 3 weeks later with grafts of viable native tumor tissue (challenge grafts) at a distance (left side) from the area previously treated (right side) to test their susceptibility to tumor growth. The challenge grafts failed to grow in 11 of the 13 rats in which suspensions of minced tumor and adrenalin had not grown; in 13 of the 20 rats in which treated tumors had been absorbed following intratumoral injections with adrenalin; in the 7 rats in which tumors atrophied following damage to their circulation by injec-

[1] Aided by a grant in aid from the National Institutes of Health, USPHS, Bethesda, Md.

[2] With the technical assistance of Peter Demchur.

[3] Commercial product of Parke, Davis & Company.

tions of adrenalin around the tumors; and in 9 of the 21 rats in which the subcutaneous tissue had been damaged by injections of adrenalin prior to implantations of tumor grafts. The challenge grafts grew in the 6 rats in which chloretone had inactivated the tumor tissue implanted on the right side. The results showed that resistance to growth of subsequent grafts of native tumor tissue had become established in 40 of the 61 rats treated with adrenalin in the experiments described. The tumor inhibitory action seemed to be caused by damage to the vascularization of the tumor tissue, followed by its absorption.

The characteristic loss of hair previously noted in rats that received minced adrenal glands (*1*) took place in these rats treated with adrenalin.

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Erythrocyte Aggregation Factor in the Plasma and Serum of Patients with Acute Lupus Erythematosus

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It is the purpose of this preliminary communication to report a phenomenon heretofore not described, namely, aggregation of washed "O" group Rh-positive erythrocytes in a mixture of egg white and fresh plasma and serum obtained from patients with acute lupus erythematosus. The aggregation phenomenon occurs following refrigeration for ½ hr.

The erythrocyte aggregation factor is not destroyed by activating the plasma or serum at 56° C for 30 min. Strong positive plasma or serum kept at room or refrigerator temperature for 10 days gave weak to negative reactions; when kept in the frozen state for one month, positive reactions were obtained which compared favorably with the original result.

The plasma and serum samples containing the erythrocyte aggregation factor also produced the so-called L. E. cell phenomenon (*1–3*).[2] No red blood cell aggregation occurred in a control series of plasma and serum samples obtained from 150 normal subjects.

The test is carried out as follows. Fresh egg white is filtered through 2 layers of gauze, and 10 ml of the filtrate is diluted with 90 ml of physiological saline solution. The egg white is placed in the refrigerator for 24 hr. Group "O" Rh-positive erythrocytes are washed in saline solution, and a 10% suspension is made and stored in the refrigerator for 1 day.

[1] Parke, Davis & Company research fellow.

[2] We are indebted to L. Berman, Department of Pathology, College of Medicine, Wayne University, Detroit, Mich.; G. L. Pease, Division of Clinical Laboratories, and M. M. Hargraves, Division of Medicine, Mayo Clinic, Rochester, Minn., for supplying plasma samples obtained from patients with acute lupus erythematosus.

To assure an even mixture of the egg white, the solution is shaken, and 1 ml is placed in a Wassermann tube. To the egg white 0.5 ml of test plasma or serum and 1 drop of the red blood cell suspension are added. The tube is shaken until the erythrocytes are well dispersed. The test is then placed in the refrigerator for ½ hr. Upon removal, the test is centrifuged at 2,000 rpm for 1 min. The tube is gently shaken until the red blood cell button is completely broken up. A positive test shows easily visible clumps of erythrocytes. A normal control is simultaneously shaken along with the test, since the reading is started when the erythrocytes in the control are homogeneously dispersed.

A 5-tube quantitative test may be set up, and the degree of clumping recorded as 1, 2, 3, and 4+, adding amounts of plasma or serum corresponding to the test-tube number—that is, 1 drop in the first tube, 2 drops in the second tube, and so on.

A positive test may be kept in the refrigerator for several days without an appreciable breaking up of the red blood cell clumps. The clumps disappear when the test is placed in a water bath at 56° C for 1 min or at 37° C for 5–10 min. The erythrocyte aggregation phenomenon can be reinduced by placing the test in the refrigerator for ½ hr, then centrifuging and shaking as above.

Whether the cold phenomenon reported here and the so-called L. E. cell phenomenon are produced by the same factor, and whether this factor is common to diseases other than lupus erythematosus, are being investigated.

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Insect Transmission of Western X-Disease of Peaches[1]

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Western X-disease has been reported as the most serious virus disease of peaches in the northwestern United States and British Columbia (*1*). Similar diseases occurring on peach have been described under the name leaf casting yellows in California (*2*) and X-disease in northeastern United States and adjoining areas of Canada (*3*). The disease on peach in

[1] Published as Scientific Paper No. 969, Washington Agricultural Experiment Stations, Institute of Agricultural Sciences, The State College of Washington, Pullman. Federal support of the work has been from RMA funds. The Oregon State Agricultural Experiment Station has also participated in these investigations.

[2] The initial work of H. R. Wolfe from 1947 to 1949 received support from the Washington State Department of Agriculture.

[3] The work of E. W. Anthon has been supported in part by the USDA.

California has been related to the buckskin disease of cherry occurring there (*2*). Similarly, Western X-disease occurring on peach has been related to Western-X–little-cherry in Oregon (*4*) and Utah (*5*), and there is indication that there may be relationship between the two in Washington (*6*). Western X-disease, like X-disease in the East, affects chokecherries, producing red-leaf symptoms (*3, 5*).

The search for vectors during the 7 years ending with 1947 failed to incriminate any insects, despite nearly 1,000 tests with 200 species. Emphasis was placed on the Cicadellidae, with 124 species being placed on trial, and upon the Aphididae, represented by 16 species.

Extended work in 1948 and 1949 produced the first evidence of insect transmission of the Western X-disease. This was through the geminate leaf hopper, *Colladonus geminatus* (Van D.).[4] Surveys that showed it to be common in the commercial peach-growing areas of the Northwest directed attention toward this leaf hopper. Although its favorite host plants in orchards appear to be legumes and grasses, it is one of the few leaf hoppers that can be maintained indefinitely on stone fruit trees, at least when caged on them. It is found on peach during the spring and summer and occasionally becomes abundant by early autumn.

The first indication that this leaf hopper is a vector was obtained at The Dalles, Ore., in a field test plot operated by the Oregon State Agricultural Experiment Station[5] in cooperation with the United States Department of Agriculture. One J. H. Hale peach tree test-inoculated with *C. geminatus* between August 2 and September 10, 1948, gave a positive chemical test (*7*) for Western X-disease in October 1948 and produced distinct Western X-disease symptoms by June 21, 1949. The symptom-showing branch was growing from precisely the place where the leafhopper cage had been attached. This tree was the only one at this location that showed any reaction out of 28 peach trees exposed to this species of leaf hopper.

Additional transmissions were achieved by December 1949, with small, potted Lovell peach seedling trees in the greenhouse of the Tree Fruit Experiment Station[6] at Wenatchee, Wash. Six cases of Western X-disease were produced in one series of 18 trees test-inoculated with *C. geminatus*, and 6 additional trees developed fair to questionable symptoms and gave positive reactions to chemical tests (*7, 8*). In the present report only the trees which developed typical symptoms on leaves are being regarded as cases of transmission (Table 1).

All the 15 check trees in the series are still normal.

[4] The leaf hoppers used in these experiments were identified by P. W. Oman, U. S. Bureau of Entomology and Plant Quarantine, Division of Insect Identification.

[5] The Oregon State Agricultural Experiment Station made possible the Oregon studies, with J. A. Milbrath, plant pathologist, H. J. O'Reilly, leader of The Dalles Experimental Area, and S. C. Jones, entomologist, collaborating. The work of L. S. Jones was done at this location.

[6] The work of H. R. Wolfe and E. W. Anthon was done at this location. The writers wish to express their appreciation to R. C. Lindner, E. L. Reeves, E. C. Blodgett, and H. C. Kirkpatrick for their helpful assistance and aid in diagnosis.

TABLE 1

TRANSMISSION OF WESTERN X-DISEASE TO LOVELL PEACH SEEDLINGS BY *Colladonus geminatus* (VAN D.)

Symptoms	No. trees
Typical	6
Fair	3
Questionable	3
None	3
Tree died	3

Two of the test trees showing typical symptoms were approach-grafted to normal Lovell peach seedlings of the same age. One of the approach-grafted trees displayed symptoms within 60 days.

Significant facts relating to the 7 cases of Western X-disease recorded as transmitted by *C. geminatus*, one in the field test plot in Oregon and 6 in the greenhouse in Washington, are itemized below:

1. In order to insure the maximum possibility of acquiring the virus, the leaf hoppers were allowed to feed on infected cherry as well as on infected peach before being confined on the healthy peach test trees that reacted. Whether the leaf hoppers acquired the virus from cherry or peach, or both, in this series of experiments is not known.

2. Sixty to 130 days elapsed between the first exposure of leaf hoppers to inoculum and their final feeding on the peach test trees. In the greenhouse tests, the insects fed on inoculum as nymphs and adults, but fed on the test trees only as adults.

3. In the 6 greenhouse tests a period of 56 days elapsed from the time the insects were removed from the inoculum until the time they were caged on the small peach test trees to which they transmitted the disease. During this period they were confined upon normal peach and cherry trees in the field. This indicates retention of the virus in the vector for this period.

4. In 2 cases where infective leaf hoppers were first allowed to feed on a small Lovell peach test tree in the greenhouse for 11 days, and then moved to a second Lovell test tree for 14 days, the second tree developed typical Western X-disease symptoms, whereas the first tree developed only questionable symptoms.

5. One test tree became diseased following feeding by a single adult leaf hopper. As many as 25 leaf hoppers were fed on the other test trees.

6. The first symptoms on the 6-in. Lovell peach seedlings in the greenhouse appeared 46 days after exposure to the vectors.

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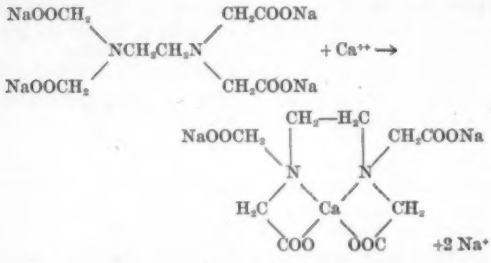
Comments and Communications

Demineralization of Hard Tissues by Organic Chelating Agents

THE sodium salts of ethylene-diamine tetracetic acid are noncolloidal organic chelating agents that resemble the inorganic polyphosphates (e.g., sodium hexametaphosphate) in their ability to form soluble nonionic chelates with a large number of metallic ions. The reaction with calcium is thought to proceed as follows:



The resulting complex is stable over a wide range of temperature (*1*). Complex compounds with calcium and other heavy metal ions are formed at variable hydrogen ion concentrations. These compounds are formed most efficiently in alkaline solutions (*2*). Since decalcification of bone and other hard tissues has hitherto only been accomplished in acid media, it was of interest to see whether these chelating agents would make a suitable demineralizing medium.[1]

Preliminary investigations have shown that demineralization in saturated aqueous solutions at pHs ranging from 5.0 to 10.3 can be accomplished. The solubility ranges from 11 g/100 ml water for the disodium salt (pH 5.0) to 103 g/100 ml water for the tetrasodium salt (pH 10.3). The time required is about the same as that needed for a comparable specimen in the formic-citric acid method of Morse (*3*), and slightly longer than that required for 5% HNO_3. Preservation of structural detail and of the staining properties of the tissues seems excellent. This was particularly evident in the elements of the pulp and bone marrow. Further experiments to determine the optimal pH and concentration of the chelating compounds for the preservation of enzymes and tissue elements are now being conducted.

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[1] The chelating agents used in this work were obtained from Alrose Chemical Company, Providence, R. I., and the Bersworth Chemical Company, Framingham, Mass.

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Zoological Nomenclature: Notice of Proposed Suspension of the Rules in Certain Cases for the Avoidance of Confusion and the Validation of Current Nomenclatorial Practice (A. (n.s.) 7)

NOTICE is hereby given that the possible use by the International Commission on Zoological Nomenclature of its plenary powers is involved in applications relating to the undermentioned names included in Parts 1 to 4 of the *Bulletin of Zoological Nomenclature*, each of which parts was published on April 20, 1951:

(1) *Applications in Part 1*

1) *Pleurocera* Rafinesque, 1818 (Class Gastropoda), (pp 6–17) (File 83).
2) *Aphidius* Nees, 1818 (Class Insecta, Order Hymenoptera), (pp. 18–20) (File 149).
3) Trivial name *ajax* Linnaeus, 1758 (as published in the combination *Papilio ajax*), (Class Insecta, Order Lepidoptera) (pp. 26–30) (File 192).
4) *Mytilus* Linnaeus, 1758 (Class Pelecypoda), (proposed validation of an error in *Opinion* 94), (pp. 31–32) (File 193).

(2) *Applications in Part 2*

5) *Scaphander* Montfort, 1810 (Class Gastropoda), (pp. 35–36) (File 378).
6) *Monoculus* Linnaeus, 1758 (pp. 37–39) (File 377).
7) *Rantus* Dejean, 1833 (Class Insecta, Order Coleoptera), (pp. 40–45) (File 171).
8) *Acantholyda* Costa, 1894 (Class Insecta, Order Hymenoptera), and *Acanthocnema* Becker, 1894 (Class Insecta, Order Diptera), (p. 46) (File 175).
9) *Rhina* Latreille [1802–1803] and *Magdalis* Germar, 1817 (Class Insecta, Order Coleoptera), (pp. 47–55) (File 202).
10) *Cardinia* Agassiz [1841] (Class Lamellibranchiata), (pp. 59–64) (File 208).

(3) *Applications in Part 3*

11) Trivial name *sirtalis* Linnaeus, 1758 (as published in the combination *Coluber sirtalis*), (Class Reptilia) (pp. 67–68) (File 433).
12) *Crangon* Weber, 1795, *Alpheus* Weber, 1795, *Crangon* Fabricius, 1798, and *Alpheus* Fabricius, 1798 (Class Crustacea, Order Decapoda), (pp. 69–80) (File 231).
13) *Scyllarides* Gill, 1898 (Class Crustacea, Order Decapoda), (pp. 81–82) (File 473).
14) *Lysiosquilla* Dana, 1852 (Class Crustacea, Order Stomatopoda), (pp. 83–85) (File 474).

15) *Odontodactylus* Bigelow, 1893 (Class Crustacea, Order Stomatopoda), (pp. 86–87) (File 475).

16) All names for "Petrificata" in Vol. 3 of Linnaeus, 1768, *Systema Naturae* (ed. 12) and in corresponding portions of the following later editions of the above work: (*a*) Gmelin (J. F.), 1793, *Syst. Nat.* (ed. 13) Vol. 3; (*b*) Houttuyn (M.), 1785, *Natuurlyke Historie*, Vol. 3; (*c*) Turton (W.), 1806, *Gen. Syst. Nature*, Vol. 7 (p. 66) (File 418).

17) *Conchidium* Oehlert, 1887, and *Pentamerus* Sowerby (J.) 1813 (Class Brachiopoda), (pp. 89–96) (File 286).

(4) *Applications in Part 4*

18) *Ligia* Weber, 1795, *Ligia* Fabricius, 1798, and *Carcinus* Leach, 1814 (Class Crustacea, Order Decapoda), (pp. 99–102) (File 209).

19) *Capsus* Fabricius, 1803 (Class Insecta, Order Hemiptera), (pp. 103–104) (File 211).

20) The trivial names *quadratus* Fabricius, 1787, and *albicans* Bosc, 1801–1802, as alternative trivial names for the Sand Crab (Class Crustacea, Order Decapoda) (p. 105) (File 271).

21) *Tettigonia* and *Acrida*: proposed validation as from Linnaeus, 1758 (application submitted under *Opinion* 124), (pp. 106–118) (File 328).

2. The present notice is given in pursuance of decisions taken, on the recommendation of the International Commission on Zoological Nomenclature, by the Thirteenth International Congress of Zoology, Paris, July 1948 (*Bull. Zool. Nomenclature*, 4, 51–56, 57–59 [1950]; *ibid.*, 5, 5–13, 131).

3. Any specialist who may desire to comment on any of the foregoing applications is invited to do so in writing to the Secretary to the International Commission, 28 Park Village East, Regent's Park, London, N. W. 1, Eng., as soon as possible. Every such comment should be clearly marked with the commission's file number as given here.

4. If received in sufficient time before the commencement by the International Commission of voting on the applications in question, comments received in response to the present notice will be published in the *Bulletin of Zoological Nomenclature*; applications received too late to be so published will be brought to the attention of the International Commission at the time of the commencement of voting on the application in question.

5. Under the decision by the International Congress of Zoology specified in paragraph 2 above, the period within which comments on the applications covered by the present notice are receivable is a period of 6 calendar months calculated from the date of publication of the relevant part of the *Bulletin of Zoological Nomenclature*. The four parts now in question were published on April 20, 1951. In consequence, any comments on the applications published in those parts should reach the Secretariat of the International Commission at latest by October 20, 1951.

FRANCIS HEMMING
Secretary to the International Commission on Zoological Nomenclature

Protochemical Cells

ELECTROCHEMICAL cells derive their energy in large part from oxidation-reduction reactions—that is, from electron exchanges. If, however, an oxidizing and a reducing substance are directly mixed, the resulting electron exchange yields no available electrical work. In order to obtain such work from these chemical reactions, it is necessary to separate spatially the site at which oxidation takes place, the anode, from the site at which reduction is occurring, the cathode, and also to provide means for electron transport at these sites by metallic conduction.

In living cells metabolic processes involving oxidation-reduction occur, but these cannot be immediate energy precursors for bioelectric phenomena because metallic conductors are not available for the required electron transport.

Can electrical work arise from proton exchanges in a manner analogous to electron exchanges? That is, can it arise from acid base rather than oxidation-reduction reactions? Electrical work should appear if the sites at which protons are released and at which they are accepted are separated, and if protonic conductors exist.

The conductance of water, hydrogen ions (H_3O^+), and hydroxyl ions (OH^-) is due largely to proton jumps, similar to the electron jumps that account for metallic conduction. The glass "electrode" provides a familiar example of a proton exchange site which affects the electrical potential of the cell of which it forms a part. It is well known that a glass membrane does not function as a hydrogen ion electrode until it is properly aged in water. The proton reaction at the glass-solution interface may be written as

$$H_2O + H^+ = H_3O^+$$

or

$$OH^- + H^+ = H_2O.$$

These reactions are evidently analogous to the iodine-iodide electrode process,

$$I + \varepsilon^- = I\varepsilon^-,$$

for example, which takes place on the surface of an inert electron conductor such as platinum. The platinum serves to bring in or take out electrons, and the glass performs a similar function with protons.

Let us consider an isothermal electrochemical cell (*A*), consisting of a (platinum) hydrogen electrode, a solution containing hydrogen ions and chloride ions, and a silver-silver chloride electrode:

$$(A) \quad \underset{\text{(electrode)}}{\text{(Pt) } H_2} \;\Big|_{(a)}\; \underset{H_3O^+,\ Cl^-,\ \text{etc.}}{\text{solution}} \;\Big|_{(b)}\; \underset{\text{(electrode)}}{AgCl, Ag}$$

At the surface (*a*) the reaction is

$$\tfrac{1}{2}H_2 + H_2O = H_3O^+ + \varepsilon^-$$

and at (*b*)

$$Ag^+Cl^- + \varepsilon^- = Ag^+\varepsilon^- + Cl^-.$$

The total potential of this cell depends on (*a*) the pressure of the hydrogen gas and the activity of the water and of the hydrogen ion constituent; (*b*) the

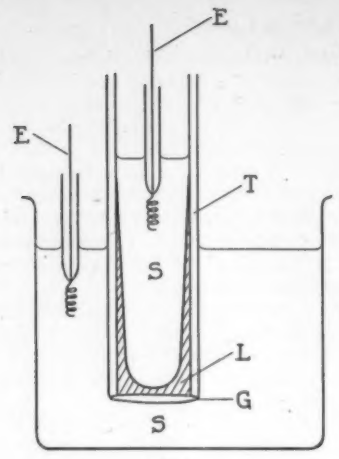


FIG. 1.

activity of the chloride ion constituent (silver chloride and silver, $Ag^{+}\varepsilon^{-}$, have constant activity since both are present in solid phase); and (*c*) the relative fugacities of the electrons (ε^{-}) from the platinum and from the silver.

A cell (*B*), involving proton rather than electron exchange, that I have studied, which is analogous to this electrochemical one, is the following:

Glass "electrode" (*B*)	Solution H_3O^+, Ba^{++}, Cl^-	Lauric acid (HL) Barium laurate (BaL_2)
	(*a*)	(*b*)

At the surface (*a*) the reaction is

$$H_3O^+ = H_2O + H^+,$$

and at (*b*)

$$Ba^{++}L_2^{=} + 2H^+ = 2HL + Ba^{++}.$$

Here the total potential of the cell depends on (*a*) the activity of the water and of the hydrogen ion; (*b*) the activity of the barium ion (BaL_2 and HL, being relatively insoluble, are present in the solid phase so that their activities are constant); and (*c*) the relative fugacities of the protons (H^+) from the glass membrane and from lauric acid.

In the electrochemical cell (*A*), the metals at (*a*) and (*b*), where electron exchanges take place, are called electrodes. It may be well to call the glass at (*a*) and the lauric acid at (*b*) where proton exchanges take place in cell (*B*) *protodes*, and to call this type of cell a *protochemical* cell.

Since existing electrical measuring instruments are metallic, it is necessary to couple a protochemical cell such as just described to a metallic system. In the experiments to be described, this was accomplished with the aid of silver-silver chloride electrodes. The complete cell is shown in Fig. 1 and consists of a glass tube (*T*), on one end of which is fused a thin membrane (*G*) of .015 Corning glass. The inner surface of this membrane is coated with lauric acid and barium laurate (*L*), which extends along the inner wall of the tube. The solutions (*S*) of the same composition were buffered and contained barium chloride. Two silver-silver chloride electrodes (*E*), one placed in the beaker and the other within the tube, complete the cell:

Ag, AgCl	Solution (*S*)	.015 Glass	HL BaL_2	Solution (*S*)	AgCl, Ag.
	(*a*)	(*c*)		(*b*)	

This is equivalent to cell (*B*), since the silver-silver chloride electrodes are both bathed by solutions of the same composition and therefore do not contribute to the cell potential.

The solutions used covered a concentration range between 1 and .005 molal in barium and a range of pH between about 1 and 8. If the mechanism described

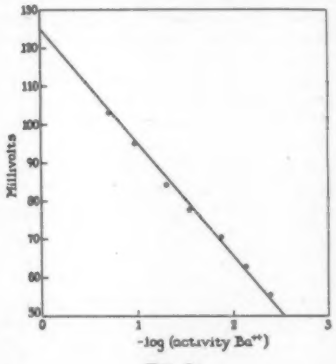


FIG. 2.

for (*B*) is correct, the potential of this protochemical cell should vary linearly, at constant pH, with the logarithm of the barium activity, log $m\gamma$, in which γ is the mean ionic activity coefficient at the barium concentration m. Results of one series of measurements at pH 4.66 are shown in Fig. 2 and indicate that such is actually the case. The straight line through the observed points has been drawn with the theoretical slope of $.0295 = \frac{2.3RT}{2F}$, two protons being involved in the protochemical reaction involving barium at surface (*b*).

Similar results have been found at other values of pH, from 1 to 8, but with the theoretically expected change in the scale of ordinates due to the proton reaction at (*a*). We are evidently dealing here with a barium protode at (*b*) and the familiar hydrogen protode at (*a*). Preliminary measurements on a corresponding cell with calcium instead of barium also indicate calcium protode behavior.

THEODORE SHEDLOVSKY
The Rockefeller Institute for Medical Research
New York

Association Affairs

Association Finances

Howard A. Meyerhoff, *Administrative Secretary*

CONDENSED statements of Association finances for the year 1949, prepared by the auditing firm of G. P. Graham & Company, are published herewith, pursuant to a vote of the Executive Committee, in order that the membership may be fully informed regarding the Association's financial condition.

The first two statements summarize operating receipts and expenditures, and it will be noted that 1949 SCIENCE annuity payments to the Cattell estates were drawn from the excess of receipts over expenditures in the operating account. As indicated in the note, the remainder of the excess is available as a reserve against future annuity payments, which included a stipulated amount of $67,497.07, plus an inflation adjustment that would total $47,150.75 if computed at the 1950 rate. Efforts to make immediate settlement of the full amount due have not been successful.

The last two statements summarize the situation relative to the Association's investment funds which, except for minor withdrawals from the small Building Fund, remained essentially unchanged during 1949 (*Science*, 110, 637 [1949]). Although $18,006.50 is available for research grants and other Association-sponsored activities, this is a small sum for an organization of 46,000 members trying to advance science. The many excellent uses to which additional income from investments can be put are obvious, and it is hoped that members will give thought to ways and means of increasing the endowment.

Washington, D. C.
October 11, 1950

To the Council of the
American Association for the Advancement of Science
Washington, D. C.

We have examined the balance sheet of the Operating Fund of the American Association for the Advancement of Science as at December 31, 1949, and the statement of receipts and expenditures for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying financial statements as supplemented by the notes thereto present fairly the financial position of the Operating Fund of the American Association for the Advancement of Science as at December 31, 1949, and the results of its operations for the year then ended.

G. P. GRAHAM & COMPANY
By H. A. O'Neill

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
OPERATING FUND
BALANCE SHEET AS AT DECEMBER 31, 1949

Assets

Current assets			
Cash		$228,377.25	
Accounts receivable		21,035.49	
U. S. Treasury bills		249,317.50	$498,730.24
			$498,730.24

Liabilities

Current liabilities			
Accounts payable			$ 48,782.76
Deferred income			
Prepaid dues and fees		$195,776.69	
Prepaid journal subscriptions		45,881.63	241,658.32
Unallocated funds (net worth)			
Balance January 1, 1949		$ 94,479.16	
Add: Excess of receipts over expenditures		141,733.94	
		$236,213.10	
Deduct: 1949 SCIENCE annuity	$16,643.04		
Inflation allowance on annuity	11,280.90	27,923.94	
Balance December 31, 1949			208,289.16
			$498,730.24

Note: The journal SCIENCE was acquired in 1944 at a stated cost of $166,430.69, payable over a period of ten years, together with such additional as may be determined each year under the inflation clause of the contract. Total payments to December 31, 1949, amounted to $146,223.22. No liability has been shown on the above statement for the balance of $67,497.07 which is payable on the stated cost price of the journal. (Computed at the 1950 rate, the additional for inflation would amount to $47,150.75, making a total of $114,647.82 as a liability against the balance of unallocated funds.)

American Association for the Advancement of Science
Operating Fund
Statement of Receipts and Expenditures for the Year Ended December 31, 1949

Receipts			
Dues and entrance fees			$261,722.85
Journals			
Subscriptions			
From Treasurer's accounts (life, 50-year, and emeritus members)	$ 2,686.50		
Members special subscriptions	16,671.10		
Nonmember subscriptions	57,236.05	$ 76,593.65	
Advertising		141,871.67	
Miscellaneous sales		3,183.11	221,648.43
Publications			
Binders		$ 1,264.24	
Symposium volumes		4,798.53	
Proceedings and directory		3,423.50	9,486.27
New York meeting and exhibit			44,189.44
Rental income			1,499.70
Miscellaneous			705.87
			$539,252.56
Expenditures			
Administrative and general expense		$ 53,907.44	
Building expense		5,174.88	
Executive Committee		3,697.53	
General Secretary		1,717.71	
Allowance to divisions		5,842.00	
Section expenses		2,120.75	
Circularization—new members		6,382.59	
Meetings and exhibits		29,955.18	
Journals		273,426.84	
Publications		8,583.98	
Employees' retirement plan		6,085.00	
Miscellaneous		624.72	397,518.62
Excess of Receipts over Expenditures			$141,733.94

Washington, D. C.
October 11, 1950

To the Council of the
American Association for the Advancement of Science
Washington, D. C.

We have examined the balance sheet of the Treasurer's accounts of the American Association for the Advancement of Science as at December 31, 1949, and the statement of cash receipts and disbursements for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying financial statements present fairly the financial position of the Treasurer's accounts of the American Association for the Advancement of Science as at December 31, 1949, and the cash receipts and disbursements for the year then ended.

G. P. Graham & Company

By H. A. O'Neill

American Association for the Advancement of Science
Treasurer's Accounts
Balance Sheet as at December 31, 1949

Assets

Endowment and reserve funds			
Cash awaiting investment (overdraft)		$ (4,321.37)	
Securities		253,470.02	$249,148.65
Building fund			
Cash		$ 15,545.49	
Securities		12.50	
Real Estate			
1515 Massachusetts Avenue	$59,334.15		
Other	93,963.05	153,297.20	168,855.19
Current funds			
Cash			21,958.10
			$439,961.94

Liabilities and Reserves

Endowment and reserve funds			
For research		$119,716.15	
For general purposes		103,517.25	
For special purposes		9,025.00	
Treasurer's reserve fund		16,890.25	$249,148.65
Building fund			168,855.19
Current funds			
Liabilities			
Thousand dollar prize fund	$ 1,000.00		
Academy grants	1,908.05		
Special academy grants	500.00		
Westinghouse science writers' award fund	490.05		
AAAS—UNESCO fellowship fund	53.50	$ 3,951.60	
Unappropriated income			
For research	$ 4,205.29		
For general purposes	3,712.62		
Jane M. Smith fund	985.84		
Luella A. Owen fund	17.60		
A. G. Stillhamer fund	662.15		
Unexpended balances of previous years	8,423.00	$ 18,006.50	21,958.10
			$439,961.94

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
TREASURER'S ACCOUNTS

STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS YEAR ENDED DECEMBER 31, 1949

Cash balances January 1, 1949			$ 55,294.45
Receipts			
Endowment and reserve funds			
Life membership fees	$ 1,050.00		
Income added to reserve fund	554.26		
Redemption and sales of securities	140,698.55	$142,302.81	
Building fund			
Contributions	$ 103.50		
Income from securities	8.42		
Sales of securities	303.42	415.34	
Current fund			
Contributions for special academy grants	$ 400.00		
Westinghouse science writers' award fund	6,476.24		
Income from investments	8,562.53		
Deceased emeritus life membership fees	800.00	16,238.77	158,956.92
			$214,251.37
Disbursements			
Endowment and reserve funds			
Fees of deceased emeritus life members transferred to Jane M. Smith fund income	$ 800.00		
Securities purchased	156,699.92	$157,499.92	
Building fund expenses			
Salaries	$ 7,569.00		
Rent and miscellaneous	721.75	8,290.75	
Current fund			
Westinghouse science writers' award fund	$ 7,139.63		
Thousand dollar prize fund	1,000.00		
Income allocated to Treasurer's reserve	554.26		
Special academy grants	300.00		
Academy grants	3,480.70		
Journal subscriptions (life, 50-year, and emeritus members)	2,686.50		
Expenses	117.39	15,278.48	181,069.15
Cash balances December 31, 1949			
For investment (overdraft)		$ (4,321.37)	
For building fund		15,545.49	
For current purposes		21,958.10	$ 33,182.22

Pacific Division of the American Association for the Advancement of Science

Robert C. Miller

Secretary, Pacific Division, AAAS

THE thirty-second annual meeting of the Pacific Division will be held on the campus of the University of Southern California, Los Angeles, June 18–23. Registration will open Monday morning, June 18, at 8:30 A.M. At 1:30 P.M. there will be a visit to the Los Angeles County Museum to view the exhibits from Pleistocene asphalt deposits, and an excursion to the Rancho La Brea Tar Pits (Hancock Park). Tuesday, June 19, at 9:00 A.M. the Division Symposium on "Oceanographic Exploration in the Pacific" will be held. This will be a half-day session.

There will be three evening lectures, open to the public. On Tuesday, June 19, Ruy Finch will give an address on "Mauna Loa in Eruption." The presidential address of C. H. Danforth, entitled "The Significance of Human Anatomical Variations," will be given Wednesday, June 20. On Thursday, June 21, Harold C. Urey will deliver a lecture on "The Temperatures of the Oceans of Sixty Million Years Ago."

At least eighteen societies associated or affiliated with the Pacific Division will participate in the Los Angeles meetings with sessions for submitted papers or symposia.

Persons registering for these meetings may arrange for various interesting field trips, including the Mount Wilson Observatory, the Scripps Institution of Oceanography, the Palomar Observatory, and the California Agricultural Experiment Station, Riverside. There will be other special events for the wives of delegates.

Local arrangements are in charge of a General Committee, of which John W. Mehl, professor of biochemistry in the University of Southern California, is chairman.

Laurentian Hormone Conference

Gregory Pincus

The Worcester Foundation for Experimental Biology

THE Laurentian Hormone Conference of the AAAS will hold its 1951 meeting at Mont Tremblant Lodge, Mont Tremblant, Que., September 9–14. Attendance will be limited by the accommodations available at the hotel, but the Committee on Arrangements invites applications for attendance from interested investigators and specialists in the hormone field. The committee consists of R. W. Bates, R. D. H. Heard, A. D. Odell, E. C. Reifenstein, Jr., A. White, and G. Pincus, *Chairman*. Application blanks for attendance may be obtained from the chairman, 222 Maple Ave., Shrewsbury, Mass. Applications must be received by *June 15* to be considered by the committee.

The following program has been arranged:

I. Pituitary Hormones

Sunday evening, September 9

Chemistry of Corticotrophin: *E. B. Astwood, M. S. Raben,* and *R. W. Payne,* The Boston Dispensary

Monday morning, September 10

Purification of the Pituitary Adrenocorticotrophic Hormone: *C. J. O. R. Morris, M. L. Deaman,* and *P. Morris,* The London Hospital

Regulation of ACTH Secretion: *C. N. H. Long,* Yale University School of Medicine

Monday evening, September 10

Aspects of Pituitary-Mammary Gland Relationships: *S. J. Folley,* University of Reading

II. Sex Cycles

Tuesday morning, September 11

The Relationship of the Nervous System to the Release of Gonadotrophin and the Regulation of the Sex Cycle: *J. E. Markee, John Everett,* and *C. H. Sawyer,* Duke University School of Medicine

Some Physiological and Medical Aspects of the Gonadal Cycle of Domestic Animals: *F. X. Gassner,* Colorado Agricultural and Mechanical College

Tuesday evening, September 11

Endocrinology and Related Phenomena of the Human Menstrual Cycle: *G. V. Smith* and *O. W. Smith,* Free Hospital for Women

III. Aspects of Steroid Hormone Chemistry and Physiology

Wednesday morning, September 12

Studies on the Biosynthesis of Adrenal Cortex Hormones: *W. J. Haines,* The Upjohn Company

The Role of the Adrenal Cortex in the Regulation of Stress-induced Tissue Reactions: *T. F. Dougherty,* University of Utah College of Medicine

Thursday morning, September 13

A Comparison of the Histological Changes Induced by Experimental Hyperadrenocorticalism and Inanition: *B. L. Baker,* University of Michigan Medical School

Histamine, Hormones and Hypersensitivity: *Bram Rose,* Royal Victoria Hospital

IV. Hormones and Metabolism

Thursday evening, September 13

Studies of the Hormonal Factors which Regulate the Mobilization of Depot Fat to the Liver: *Louis Levin,* Columbia University College of Physicians and Surgeons

Friday morning, September 14

The Etiology of Diabetes Mellitus: *I. A. Mirsky,* The May Institute for Medical Research

Some Clinical Aspects of Adrenal Cortical and Fluid Metabolism: *C. W. Lloyd,* Syracuse University College of Medicine

Section E

At the Philadelphia meeting of the AAAS, the Section on Geology and Geography is planning special programs on "The Crystalline Rocks of the Older Appalachians" and "Foreign Petroleum Areas," as well as general sessions in geography and geology.

Joint meetings with other sections are also under discussion. K. K. Landes will give the address of the retiring vice president.

Those planning to participate in any of the programs are requested to file titles and abstracts (not exceeding 250 words) by *June 15* to be assured a place on the program. Final date is *September 15*. Correspondence, titles, and abstracts should be addressed to Leland Horberg, Department of Geology, University of Chicago, Chicago 37.

News and Notes

Scientists in the News

New Zealand's volcanic district will be studied by **O. P. Bergelin,** associate professor of chemical engineering at the University of Delaware. He will aid the dominion government in seeking to harness the steam and hot water from underground. Dr. Bergelin received a Fulbright scholarship after the New Zealand government had appealed for American experts in heat transfer to aid in utilizing the islands' natural thermal resources. Much of his work probably will be done at Rotorua, in the center of North Island, where the volcanological observatory is located.

Thomas P. Collier, assistant general manager of export operations for Inter-American Orange-Crush Company, has been named manager of international research operations at Armour Research Foundation of Illinois Institute of Technology.

Norman F. Conant, of the Duke University School of Medicine, is delivering a series of lectures on mycology at leading Scandinavian medical centers, at the invitation of Arvid Lindau, professor of bacteriology at the Bakteriologiska Institutionen, Lund.

I. Costero, professor of pathology, National University of Mexico, and visiting lecturer in pathology, University of Texas, is giving a series of five lectures at the University of Texas. His third lecture, May 11, will deal with "The Neuroglia Cells *in Situ* and *in Vitro*." On May 18, he will speak on "The Pathology of the Genuine Neuroglia," and on "Modern Knowledge of the Microglia in Normal and Pathological States." Three of Dr. Costero's lectures are in collaboration with **C. M. Pomerat.**

Three Americans and a Norwegian have been elected to Britain's Royal Society: **Herbert McLean Evans,** of the University of California, Berkeley, for researches in anatomy, embryology and endocrinology; **Karl Spencer Lashley,** of Yerkes Laboratories, for studies of the neurological basis of animal behavior and of the factors involved in learning; **Ralph W. G. Wyckoff,** of the National Institutes of Health, for contributions to the study of viruses; and **Carl Fredrik Stormer,** of Oslo, for researches on the motion of charged particles in magnetic fields and on auroral phenomena.

Burton R. Fisher, present program director of the Survey Research Center at the University of Michigan, has been appointed professor of sociology at the University of Wisconsin.

Frank C. Fowler, formerly of the University of Oklahoma, has been added to the staff of Midwest Research Institute, Kansas City, as petroleum consultant. From 1943 to 1946, Dr. Fowler was senior process engineer in the chemical products department at Phillips Petroleum Company. At the university since 1946, he administered both graduate and undergraduate courses and directed graduate research. He also conducted industrial research programs for the University of Oklahoma Research Institute.

Four Public Health Service nurses have been assigned to the Economic Cooperation Administration Mission in Southeast Asia. **Lillian A. Gardiner** will be chief nurse adviser for the ECA mission in Thailand, with headquarters in Bangkok. Miss Gardiner will work with **Erval R. Coffey,** Public Health Service medical officer, who is ECA medical director of the Thailand mission. **Mary Bouser, Walborg Wayne,** and **Florence Ullman** will work on health teams in Burma.

Wesley E. Gilbertson, of Atlanta, executive officer of the Communicable Disease Center, will serve as technical adviser to the U. S. delegation to the fourth World Health Assembly, which is meeting in Geneva, May 7–25. The delegation consists of **Leonard A. Scheele,** USPHS; **Roy Cleere,** state health officer of Colorado; **India Edwards,** of Washington, D. C.; **Senators Nixon** and **Lehman; H. B. Mulholland,** of Charlottesville, Va.; **Malcolm MacEachern,** of Chicago; and **Richard L. Meiling.** Mr. Gilbertson will also go to Athens to advise the Health Division of the ECA Mission to Greece on changes in the malaria control program in that area, and in London he will attend the congress of the International Union of Local Authorities.

Marcel Golay, a chief scientist of the Signal Corps Engineering Laboratories, Fort Monmouth, N. J., was presented the Harry Diamond Memorial Award for outstanding contributions in the fields of radio and electronics at the annual convention of the Institute of Radio Engineers in New York City. The award, named after a former National Bureau of Standards scientist, is presented annually in recognition of publication in professional society journals.

The Award of Merit made annually by the Alumni Association of Cornell University Medical College to an outstanding graduate has been won this year by **Connie M. Guion,** professor of clinical medicine. She is chief of the medical clinic of New York Hospital–Cornell University Medical Center and a consultant

physician on its staff. William H. Cassebaum, president of the association, presented the award during the annual meeting at New York Hospital.

The University of Miami Marine Laboratory has appointed **Ilmo Hela** assistant professor of oceanography. Dr. Hela, who is assistant professor of geophysics at the University of Helsinki and lecturer in meteorology at the Institute of Technology, University of Finland, will carry out research on the Florida Current and other water movements in the Gulf of Mexico and in the Caribbean. He will also give a course of lectures in physical oceanography.

The following appointments have been made to the Faculty of Medicine, Dalhousie University: **M. M. Hoffman,** professor of experimental medicine, and head, Department of Metabolism, Victoria General Hospital, formerly assistant director, McGill University Clinic, Royal Victoria Hospital, Montreal; **J. Gordin Kaplan,** assistant professor of physiology, formerly of the Department of Zoology, Columbia University; **N. G. B. McLetchie,** professor of pathology, formerly of the Universities of Bristol and Glascow and recently pathologist to the province of Saskatchewan; **Frank Moya,** lecturer in experimental medicine, formerly of McGill University; **Roger Reed,** professor of bacteriology, formerly bacteriologist to the Montreal General Hospital; and **R. D. Stewart,** assistant professor of biochemistry, formerly of the Worcester Foundation for Experimental Biology.

The Rumford Premium for 1951 has been awarded to **Herbert E. Ives** of Upper Montclair, N. J. The Rumford Premium, in honor of the well-known American-born scientist, Benjamin Thompson, Count Rumford, is given every second year by the American Academy of Arts and Sciences in recognition of important discoveries in heat and light. Dr. Ives, who was with the Bell Telephone Laboratories from 1919 to 1947, has made outstanding contributions to optics, including the first accurate determination of the visibility function of the average human eye, scientific methods of color measurement and specification, and other developments in the physics of light measurement.

Chih Kung Jen, research lecturer at Harvard, and **Edwin Shotland,** engineer for the Chance Vought Aircraft Co., of Dallas, Texas, are among 23 recent additions to the staff of The Johns Hopkins University Applied Physics Laboratory at Silver Spring, Md.

John B. Jewell has been made medical director of Ayerst, McKenna & Harrison Limited, New York. Formerly medical director of the Canadian division of the firm, Dr. Jewell is now in charge of medical services for both the U. S. and Canada.

Gordon Kiddoo has been appointed assistant director of the Petrochemical Research Department, National Research Corporation. Mr. Kiddoo will be in charge of the engineering economics of the petrochemical research program which National Research Corporation is undertaking jointly with Electric Bond & Share Company and United Gas Corporation.

Arthur Kirschbaum, of the University of Minnesota, has been appointed professor of anatomy and head of that department at the University of Illinois College of Medicine. He will succeed **Otto F. Kampmeier,** who requested that he be relieved from administrative duties to complete several books, one of which is an atlas of head and neck anatomy. Dr. Kampmeier will continue as professor of anatomy.

Philip Levine, of the Ortho Research Foundation of Raritan, N. J., and **Alexander S. Wiener,** of Brooklyn, are joint and equal recipients of the Passano Foundation Award for 1951. The work of Levine and Wiener relates to the discovery and clinical application of the Rhesus (Rh) factors in human blood. Presentation of the $5,000 cash award will be made during the annual meeting of the American Medical Association. Established in 1943 by the Williams & Wilkins Company, medical publishers of Baltimore, the foundation is dedicated to the encouragement of medical research.

E. D. Vere Nicoll, chief assistant to the Orthopedic and Fracture Departments, St. Batholomew's Hospital, University of London, has been appointed instructor in orthopedics at the University of Virginia.

Erik Sjöqvist has been appointed professor of classical archaeology at Princeton University. Dr. Sjöqvist has participated in archaeological excavations in Greece and on Cyprus. From 1940 to 1948 he was director of the Swedish Institute in Rome. Since 1948 he has been visiting professor at Princeton.

Under the program of the Carnegie Corporation of New York, grants-in-aid for travel and study in this country have been made to **H. W. Springer,** registrar of the University College of the West Indies, Jamaica; **Frank R. E. Mauldon,** professor and head of the department of economics at the University of Western Australia, Nedlands; **R. M. M. Cormack,** senior conservation engineer of Southern Rhodesia; **J. D. A. Collier,** state librarian of Tasmania, Australia; and **G. H. Vasey,** lecturer in agricultural engineering at the University of Melbourne.

J. McWilliams Stone, founder and president of Operadio Manufacturing Company, St. Charles, has been named to the board of trustees of Illinois Institute of Technology, filling the vacancy created by the death of **John P. Sanger.**

Hobart H. Willard professor of chemistry at the University of Michigan, has been honored in a full day seminar, in which only his former students participated. Twenty-one papers dealing with various new discoveries in chemistry were given by nineteen students, who are now professors and researchers in colleges and universities throughout the U. S. Professor Willard was also given the ACS Fisher Award in Analytical Chemistry. He has been on the Michigan faculty for 45 years.

Colleges and Universities

Workshops and special courses covering many aspects of psychology will be held this summer at: the University of Chicago, by the Committee on Human Development (July 9–August 3); Claremont College (July 23–August 4, August 8–August 18); Duke (June 11–June 23); University of Maryland (July 23–August 3); Houston (June 4–July 13); the Michigan Survey Research Center (July 23–August 17); Moreno and Psychodramatic Institutes (May 26–30, June 30–July 4, September 1–3); New School for Social Research (June 18–July 7); New York University School of Education and the New York State Association for Crippled Children and Adults (June 4–26); San Diego State College (June 18–July 27); University of Utah (June 25–30); Lynchburg State Colony, Virginia (July 16–20).

The **Hague Academy of International Law,** which resumed its activities in 1947, will hold its summer session July 16–August 11, with lectures in either English or French. Tuition is free. Application forms are available at the Secretariat, Peace Palace, The Hague.

In addition to its Israeli workshop (*Science*, **113**, 221 [1950]), **New York University** will hold three other overseas workshops. A workshop on "Human Relations in World Affairs" will be conducted through England, France, and Germany; another group will take part in a "Field Workshop in Cultural Anthropology in the Virgin Islands," and a third will also go to the Caribbean, to study the environment in which Puerto Rican children grow up. For further information write to Nazaret Cherkezian, School of Education, NYU, Washington Square, New York.

Stanford University School of Medicine will hold its annual fall postgraduate courses for practicing physicians September 10–14. Write to the office of the dean, 2398 Sacramento St., San Francisco 15, for additional information.

A variety of **summer courses for English-speaking students** will be held in Sweden this summer. Among them are "Aspects of Sweden Today," August 1–20, at Upsala, under the leadership of Torgny T. Segerstedt; "Social and Economic Development in Sweden," Jacobsberg People's College (near Stockholm), August 27–September 11; "Swedish Decorative Art and Architecture," organized by the National Association of Swedish Architects, the Swedish Institute, and the Swedish Society of Industrial Design, Stockholm, August 13–25; an International Sociological Seminar, July 10–August 1 at Marston Hill, Mullsjö, sponsored by the Institute of Social Research; and "Swedish for Foreigners," in the medieval town of Sigtuna, near Stockholm, August 1–8.

Improved undergraduate courses in psychology is the objective of a seminar to be held June 25–August 31 by a group of psychologists interested in this field. Members of the group are Claude E. Buxton, Yale; Charles N. Cofer, University of Maryland; John W. Gustad, Vanderbilt; Robert B. MacLeod, Cornell; Wilbert J. McKeachie, University of Michigan; and Dael Wolfle, Commission on Human Resources. The group intends to prepare model course outlines which will minimize overlap of subject matter, reduce the number of similar courses, and provide the basis for more systematic instruction at the undergraduate level. The project is sponsored by the University of Michigan on a grant made jointly by the Carnegie Corporation and the Grant Foundation.

Fellowships

The **Sweden-American Foundation,** Stockholm, has announced the distribution of $28,000 in scholarships to 21 young men and women from many different parts of Sweden, for study in the U. S. Subjects to be investigated include fossils, music, sociology, television, home economics, dentistry, and metallography. The foundation has also recommended eight candidates for U. S. scholarships under the Smith-Mundt Act.

The **Fund for the Advancement of Education** has inaugurated a $2,280,000 fellowship program designed to increase the teaching skill of younger college instructors. Up to 500 fellowships may be awarded for the academic year 1951–52. Application forms (returnable by *June 1*) are being mailed this week to college and university presidents. The members of the National Committee for Administration of the Fellowships, under the chairmanship of Victor L. Butterfield, Wesleyan University, are Francis Keppel, Harvard; Harvie Branscomb, Vanderbilt; Mary A. Cheek, Rockford College; Fred C. Cole, Tulane; Arthur H. Compton, Washington University; Arthur G. Coons, Occidental College; Albert W. Dent, Dillard; William C. DeVane, Yale; Paul A. Dodd, California at Los Angeles; Eldon L. Johnson, University of Oregon; Nathan M. Pusey, Lawrence College; Gilbert F. White, Haverford College; Goodrich C. White, Emory University; Payson S. Wild, Jr., Northwestern; and O. Meredith Wilson, University of Utah. Headquarters will be at 575 Madison Ave., New York.

Eli Lilly and Company has established two $1,500 fellowships in the College of Pharmacy of the University of Florida, in pharmacy and in pharmaceutical chemistry, under C. H. Becker and W. M. Lauter, respectively. A B.A. from an accredited college of pharmacy is prerequisite. P. A. Foote is dean of the college.

The **Ford Foundation,** through its Fund for the Advancement of Education, has established a fund of $1,200,000 for an unusual educational experiment. Columbia, Yale, Chicago, and Wisconsin will each accept 50 promising male students who must be under 16½ on September 15; three fifths of those selected will not be high school graduates, but must have completed the sophomore year, the tenth grade, or its equivalent. College Board examinations will be given *May 19* to those recommended by their high schools.

Applicants are urged to write at once to the College Entrance Examination Board, Princeton, N. J., declaring their intention to register for the examination and enclosing appropriate background information. Two years of work will be provided.

Tau Beta Pi graduate fellowships for 1951–52 have been awarded to Douglas R. Briggs, George L. Durfee, Frederick J. Ellert, George A. Gray, Allan K. Hammell, Frederick W. Nesline, Jr., Robert G. Rinker, and Arthur A. Wasserman. All are members of the national engineering honor society founded in 1885.

In the Laboratories

Cambridge Corporation, Syracuse, N. Y., a new company jointly owned by Arthur D. Little, Inc., and Carrier Corporation, will manufacture an air filter developed by Little. First used by the AEC to keep radioactive particles out of the atmosphere, the filter will be useful also where air must be kept dust-free or sterile. Raymond Stevens, vice president of Arthur D. Little, has been elected president of Cambridge Corporation, and David H. Northrup, of Carrier Corporation, is vice president and general manager.

The **Du Pont Company** has recently inaugurated a program providing engineering college educators with a year's experience in industry to help bridge the gap between the campus and industry. Regular salaries, plus reasonable expenses, will be paid by Du Pont. David L. Arm, dean of the School of Engineering at the University of Delaware since 1946, is the first administrative officer invited to participate in the program.

The Kendall Company, Boston manufacturer of surgical dressings, cotton textiles, and allied products, has opened the Theodore Clark Laboratory at Cambridge, Mass. Named for the late Theodore Clark, chemist and former vice president of the company, the laboratory will conduct both basic research and work on specific company problems in high polymers, under the direction of Willard M. Bright.

The International Division of **Stanford Research Institute** has organized a team of industrial experts to go to Italy to participate—on invitation from the Italian government—in an industrial survey and analysis of Italian mechanical industries. John Abbink, former president of McGraw-Hill International and chairman of the Joint Brazilian–United States Technical Mission of 1949, will be a senior member of the commission, which will include members from Stanford, Armour Research Foundation, Southwest Research Institute, and George S. Armstrong & Company.

Sinclair Research Laboratories, Inc., will take over all research activities of the Sinclair companies, including the Harvey, Ill., laboratories. E. W. Isom has been elected chairman of the board of the laboratories; P. C. Spencer, president; and W. M. Flowers and E. C. Herthel, vice presidents.

Meetings and Elections

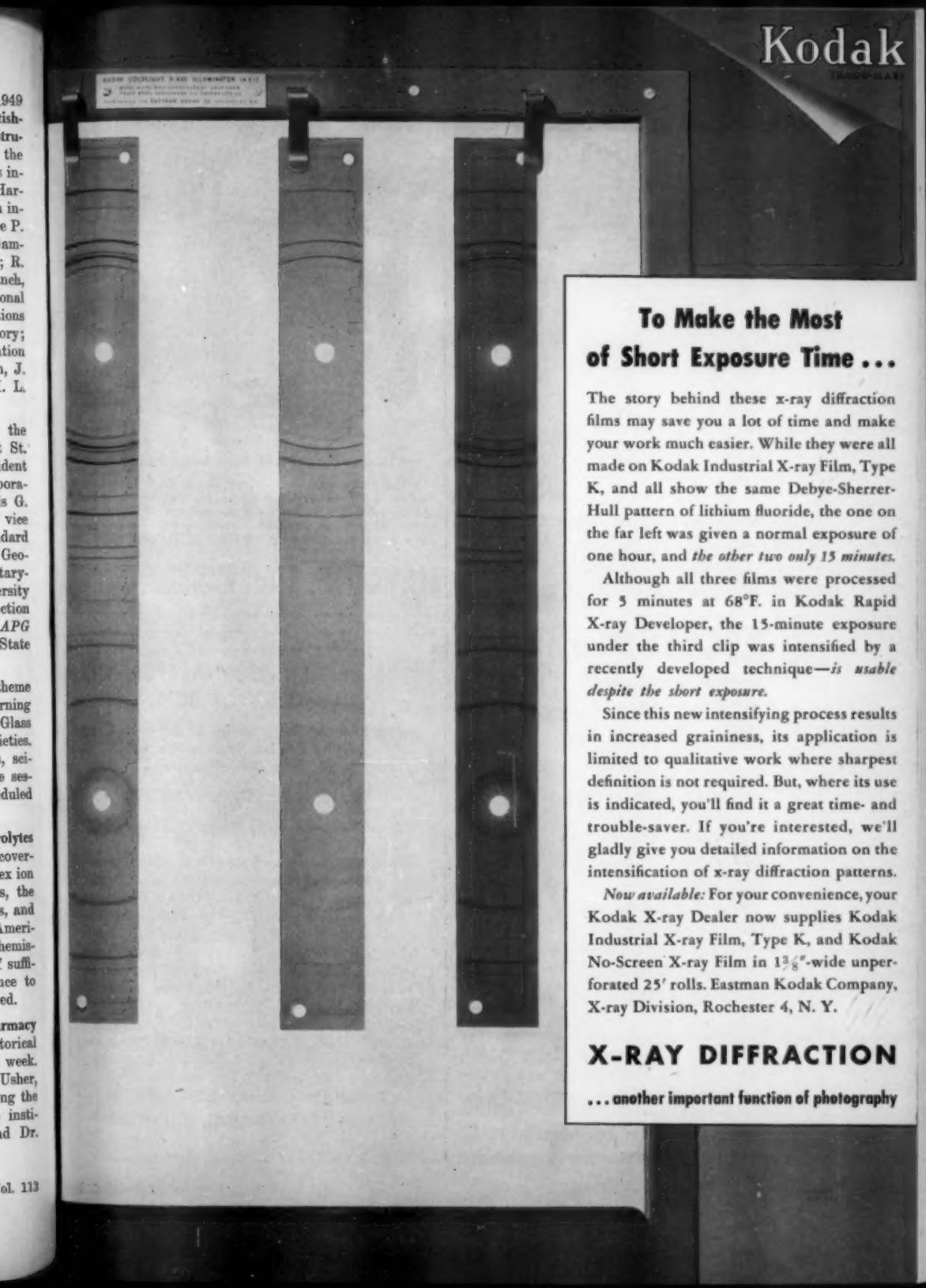
Following similar conferences at Oak Ridge in 1949 and Chalk River in 1950, a joint **American-British-Canadian Conference on Radiation Detection Instruments** has been held at Harwell this month under the technical cooperation program of the three nations involved. The first week was spent in discussions at Harwell and the second was devoted to visits to British instrument manufacturers. U. S. representatives were P. R. Bell, Oak Ridge National Laboratory; C. C. Gamertsfelder, General Electric Co., Hanford, Wash.; R. W. Johnston, AEC Radiation Instrument Branch, Washington; J. B. H. Kuper, Brookhaven National Laboratory; H. D. Levine, AEC New York Operations Office; F. R. Shonka, Argonne National Laboratory; and R. J. Watts, Los Alamos. The British delegation included Denis Taylor, E. H. Cooke Yarborough, J. Sharpe, and K. Kandia. George Cowper and I. L. Fowler were the Canadian representatives.

At the conclusion of the annual meeting of the **American Association of Petroleum Geologists** at St. Louis, April 23–26, Frank A. Morgan, vice president and manager of exploration, Richfield Oil Corporation, succeeded C. L. Moody as president. Lewis G. Weeks, of Standard Oil Co. (N.J.) became vice president, succeeding John Emery Adams, of Standard Oil of Texas; Robert H. Dott, of the Oklahoma Geological Survey, replaced Henry N. Toler as secretary-treasurer; and Kenneth K. Landes, of the University of Michigan and immediate past chairman of Section E, AAAS, took over the editorship of the *AAPG Bulletin* from Alfred H. Bell, of the Illinois State Geological Survey.

Living in Industrial Civilization is the general theme of a three-day conference to be held at the Corning Glass Center May 17–19, sponsored by Corning Glass and the American Council of Learned Societies. Approximately 100 industrialists, labor leaders, scientists, and philosophers will participate in the sessions, which will initiate a series of events scheduled for the Corning Glass Works centennial year.

A symposium on **Complex Ions and Polyelectrolytes** will be held June 18–20 at Cornell University, covering the kinetics and equilibrium aspects of complex ion formation, the polymerization of complex ions, the properties of synthetic polyelectrolytes, proteins, and ion exchange resins. The Cornell section of the American Chemical Society and the Department of Chemistry of Cornell University will be hosts. Lack of sufficient facilities necessitates restricting attendance to 350. Preregistration by *May 20* will be required.

The American Institute of the History of Pharmacy celebrated its tenth anniversary by holding a historical symposium at the University of Wisconsin this week. George Rosen, Henry M. Leicester, Abbott P. Usher, Frans Verdoorn, and George Urdang were among the symposium participants. Headquarters of the institute are at the University of Wisconsin, and Dr. Urdang has been director since its founding.



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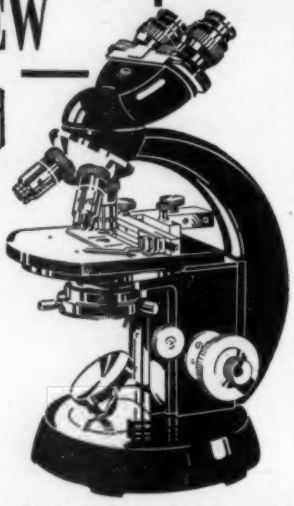

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May 17–19. American Institute of Electrical Engineers (Great Lakes District). Hotel Loraine, Madison, Wis.

May 20–26. Pan American Congress on Veterinary Medicine. Lima, Peru.

May 21–22. Sanitary Institute of America. Palmer House, Chicago.

May 21–25. International Congress of Orthopedic Surgery and Traumatology. Stockholm.

May 21–25. American Association of Cereal Chemists (Annual). Nicollet Hotel, Minneapolis.

May 21–27. Congress on Scientific and Technical Progress. Paris.

May 22–25. National Conference on Weights and Measures. Washington, D. C.

May 23–24. American Society for Quality Control (Annual). Cleveland.

May 23–26. American Association on Mental Deficiency. (Annual). Hotel New Yorker, New York.

May 23–26. American Dermatological Association. The Homestead, Hot Springs, Va.

May 24–25. Society of the Plastics Industry (Annual). Greenbrier Hotel, White Sulphur Springs, W. Va.

May 25–26. Society for Applied Spectroscopy (Annual). Socony-Vacuum Training Center, New York.

May 27–30. Dechema, Deutsche Gesellschaft für chemisches Apparatewesen EV. Frankfurt/Main.

May 27–30. American Society of Refrigerating Engineers (Spring). Hotel Statler, Detroit.

May 27–31. Society of American Bacteriologists (Annual). Edgewater Beach Hotel, Chicago.

May 28–30. Conference on Electrical Instrument Design. London.

May 28–June 6. Third World Petroleum Congress. The Hague.

May 28–June 8. Canadian International Trade Fair. Toronto.

June 3–6. Congress on Fire Resisting and Fire Retarding Paints and Varnishes. Paris.

June 3–7. National Confectioners Association. Hotel Stevens, Chicago.

June 3–8. Society of Automotive Engineers, Inc. (Summer). French Lick Springs Hotel, French Lick, Ind.

June 3–8. American Society of X-Ray Technicians (Annual). Hotel Benjamin Franklin, Philadelphia.

June 4. International Association for Dental Research (N. Y. Section). School of Oral and Dental Surgery, Columbia University, New York.

June 4–15. Joint Engineering Conference. London.

June 5. American Association of Candy Technologists (Annual). Stevens Hotel, Chicago.

June 5–8. National District Heating Association (Annual). Detroit.

June 6–8. American Dairy Science Association. University of Tennessee, Knoxville.

June 6–16. British Plastics Exhibition and Convention. Olympia, London.

June 6–16. American Heart Association (Annual). Chalfonte-Haddon Hall, Atlantic City.

June 7–8. American Management Association. Waldorf-Astoria Hotel, New York.

June 7–8. Society for Investigative Dermatology, Inc. (Annual). Ritz-Carlton Hotel, Atlantic City.

June 9–10. American Society for the Study of Sterility (Annual). Ritz-Carlton Hotel, Atlantic City.

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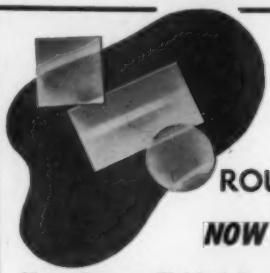

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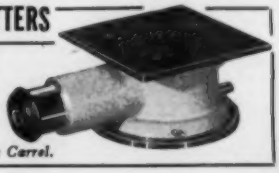

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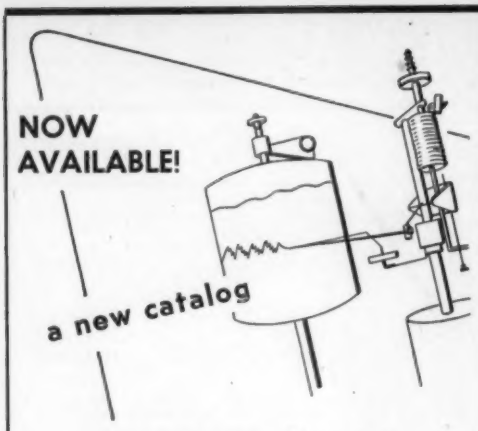

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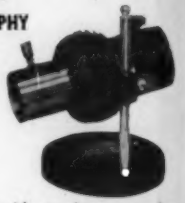

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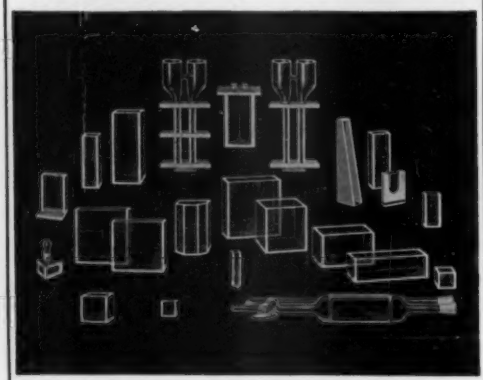

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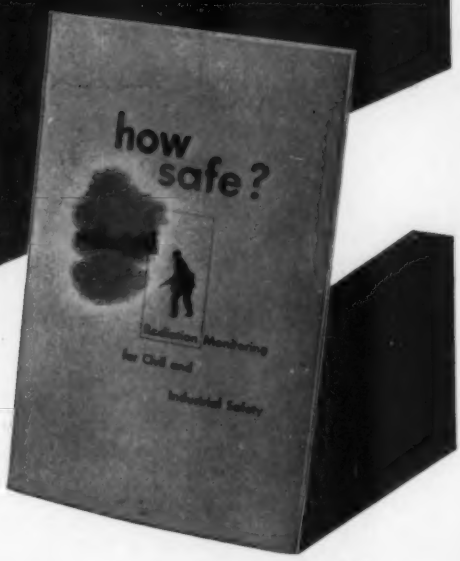

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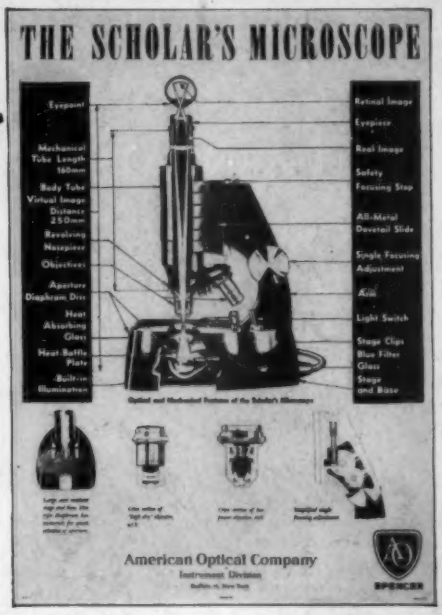

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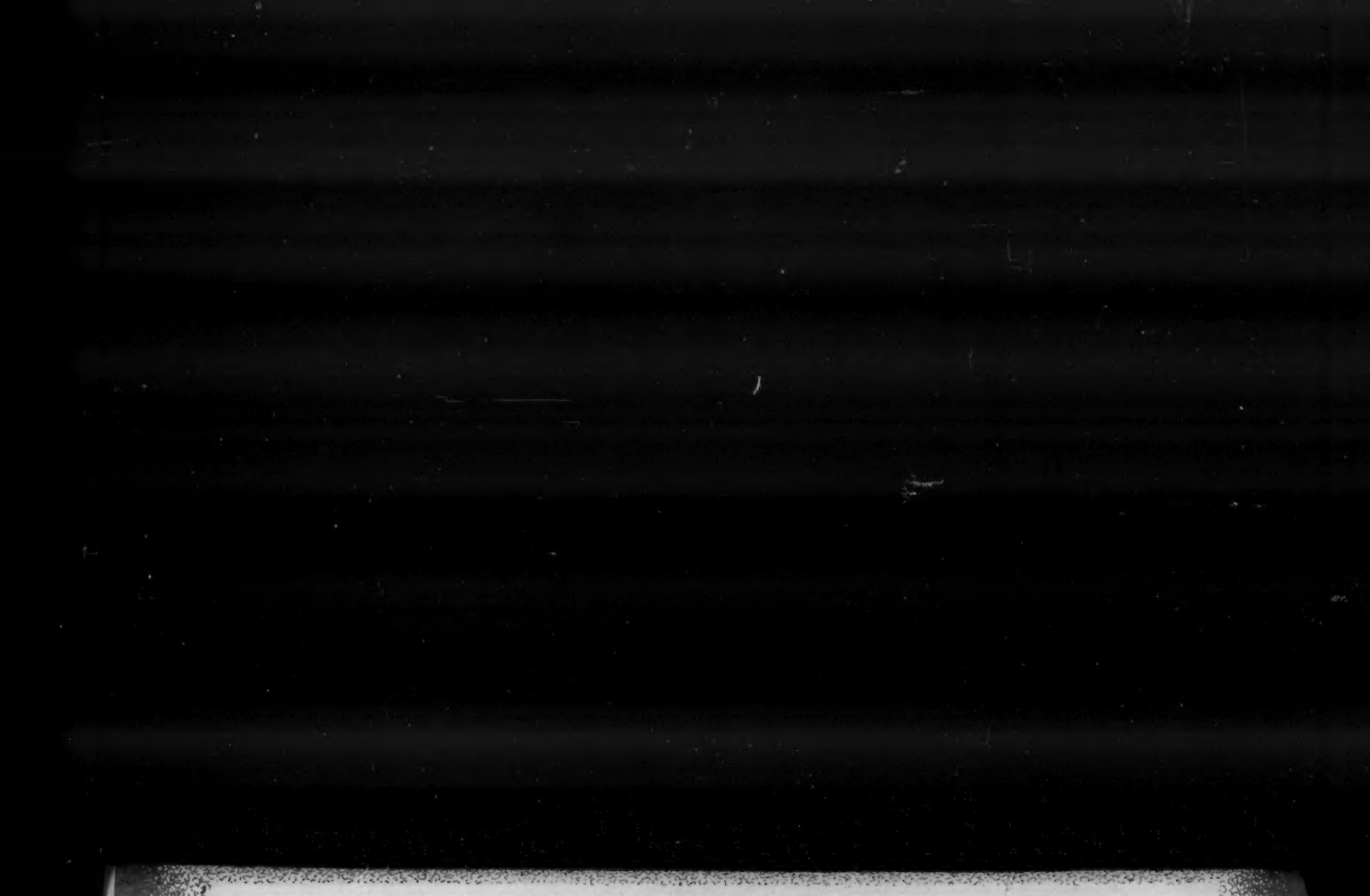
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